

Regional Air Quality Planning in the Upper Midwest: Attainment Strategy Options

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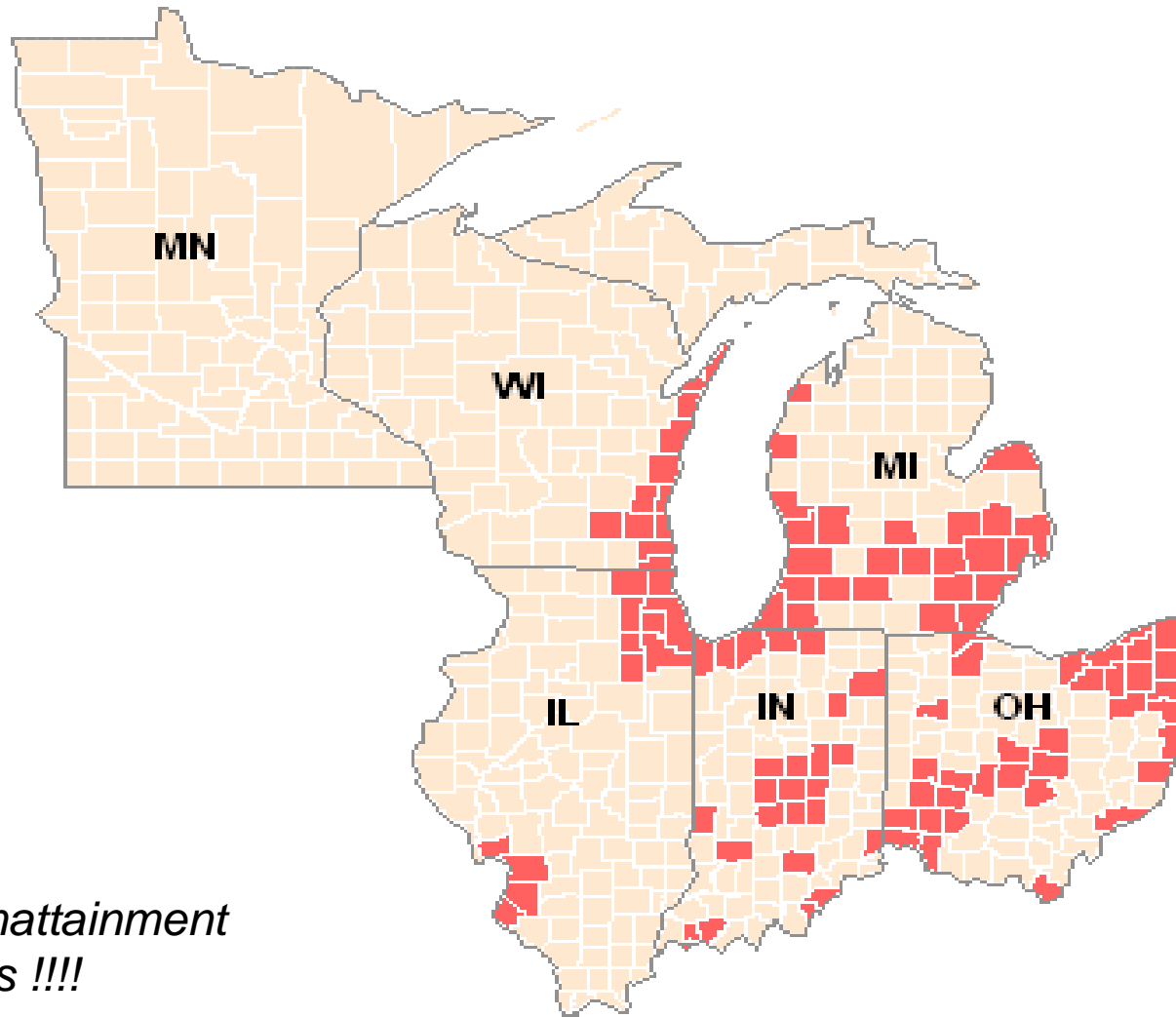
Overview

- What are the air quality problems?
 - Ozone
 - Fine Particles (PM_{2.5})
 - Regional Haze
- What are we doing about these problems?
 - Technical Analyses
 - Emission Reduction Targets
 - Control Strategy Options

Current Air Quality Problems

- Ozone
- PM_{2.5}
- Regional Haze

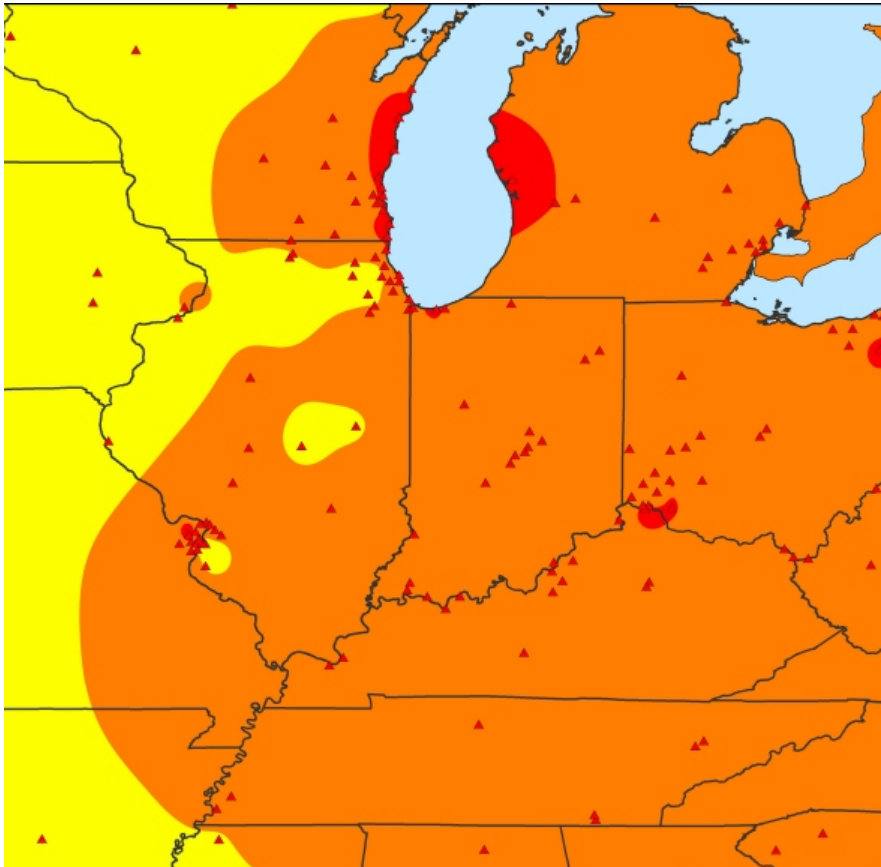
Ozone Nonattainment Areas



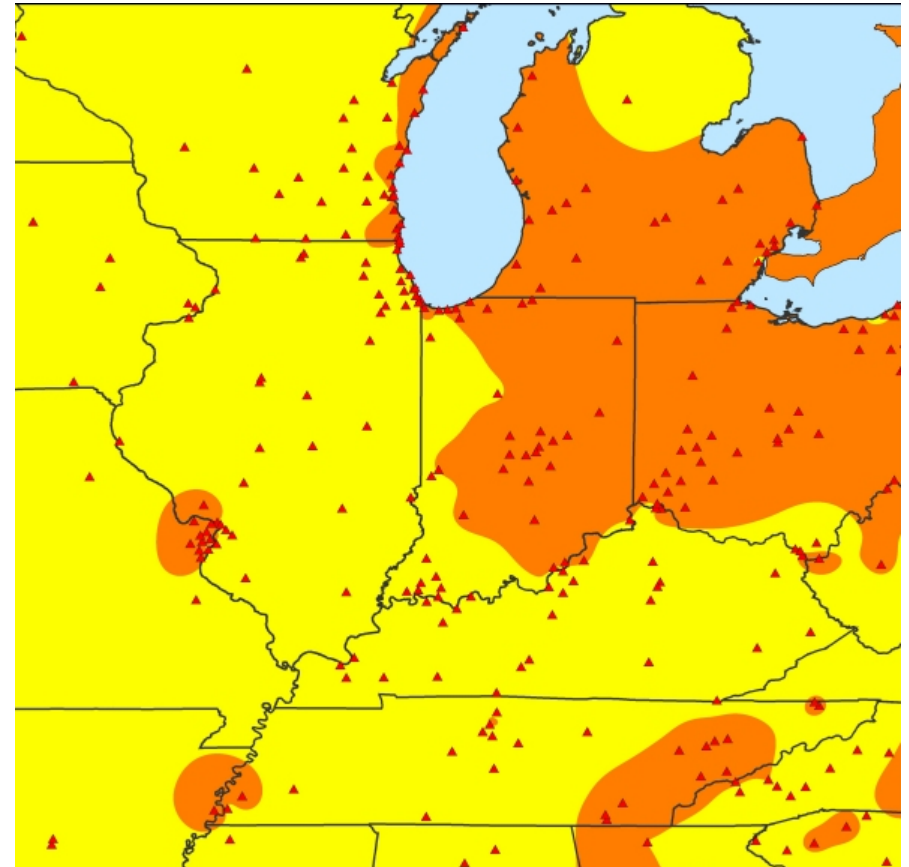
*104 Nonattainment
Counties !!!!*

Air Quality Standard = 85 ppb, 8-hour average

Ozone Spatial Pattern



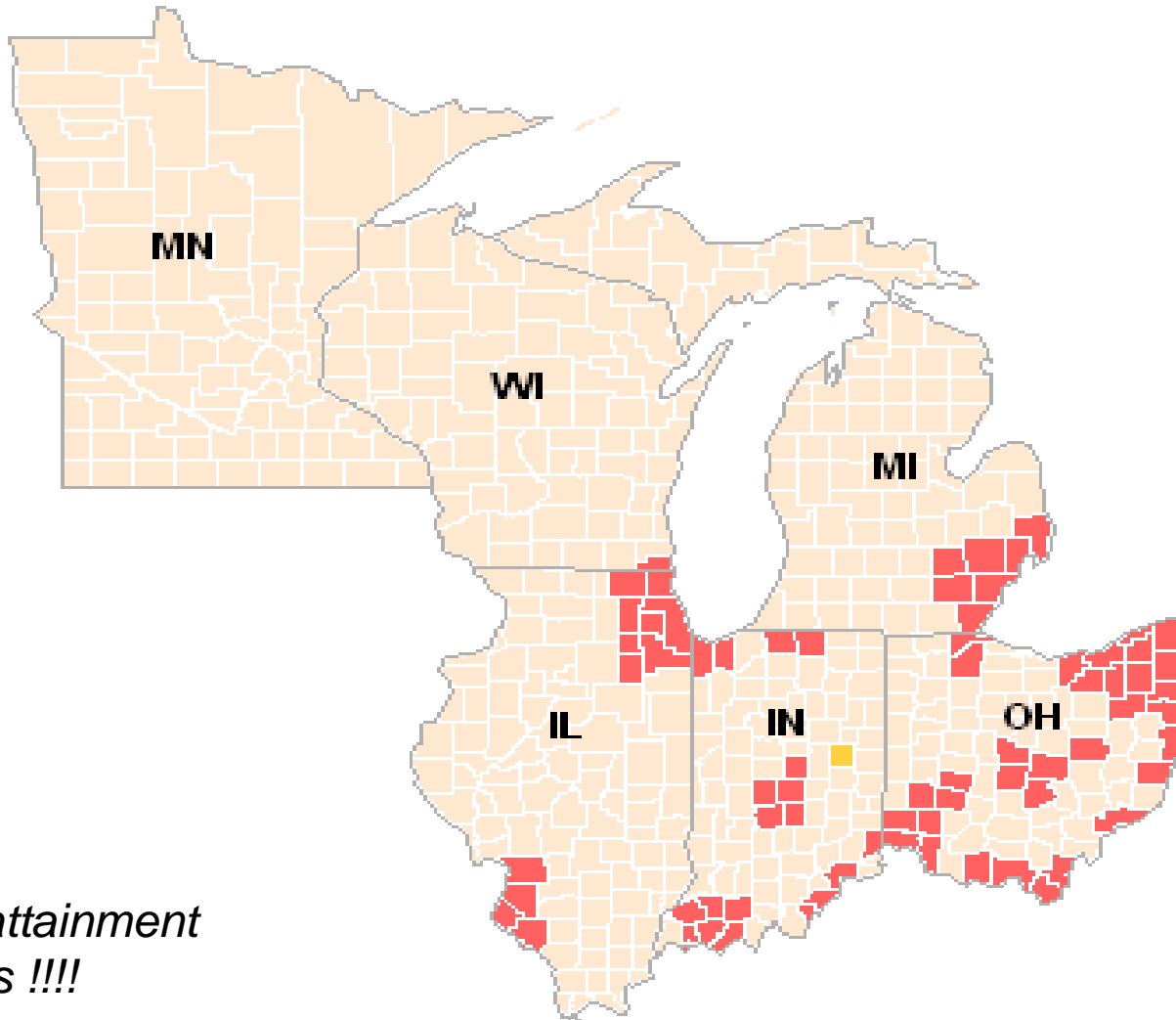
1987-1989



2001-2003



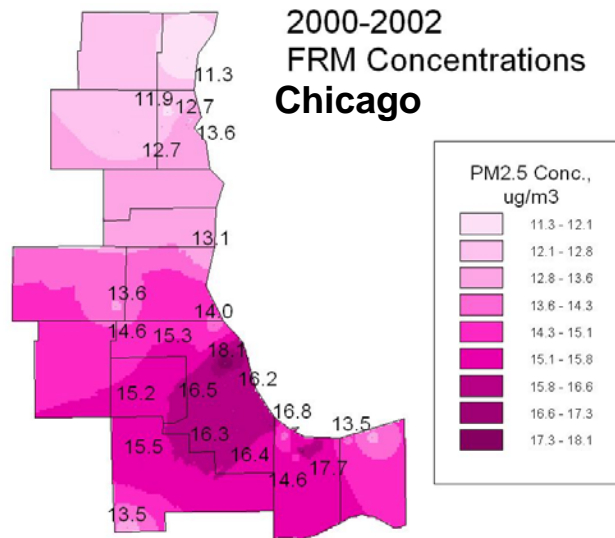
PM_{2.5} Nonattainment Areas



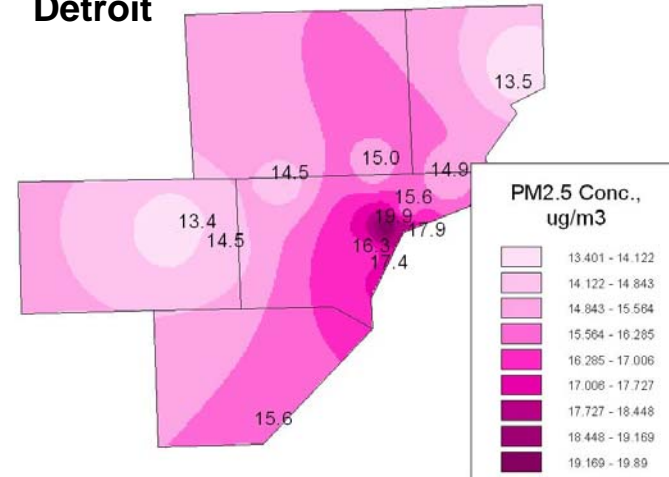
*63 Nonattainment
Counties !!!!*

***Air Quality Standard = 15 ug/m³, annual average
65 ug/m³, 24-hour average***

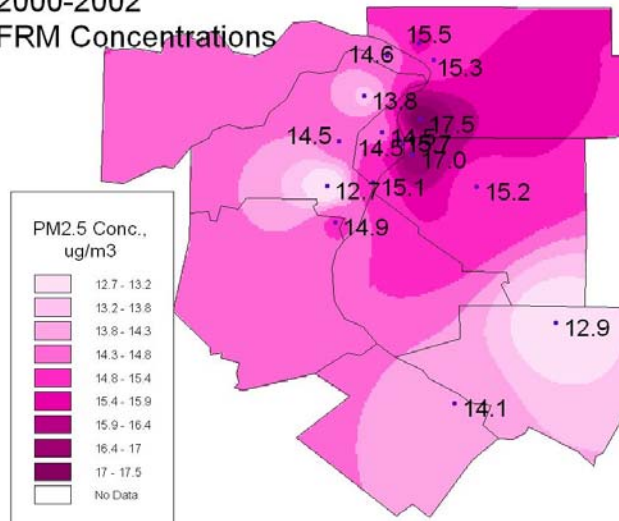
PM_{2.5} Spatial Pattern



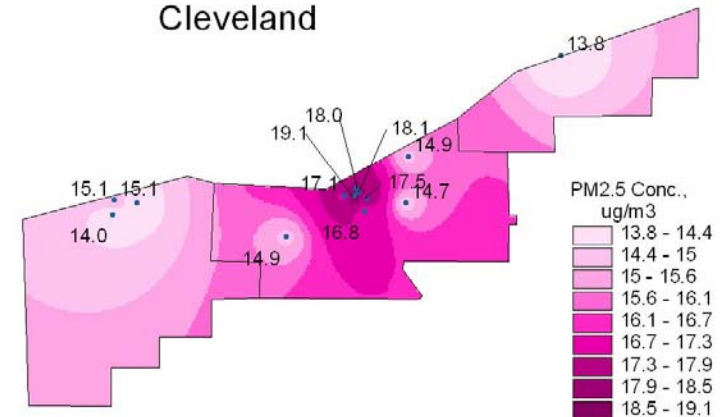
2000-2002 FRM Concentrations
Detroit



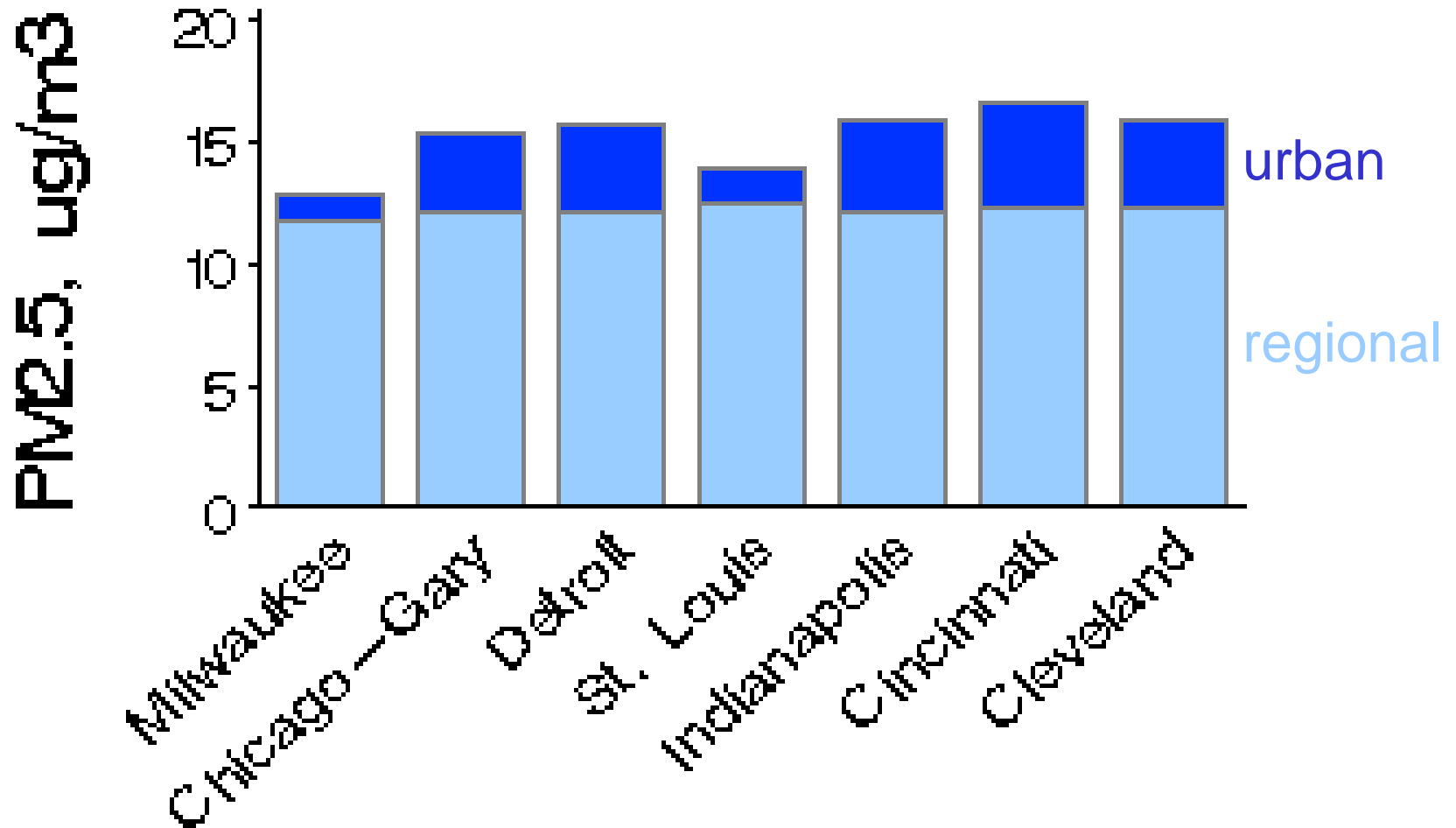
2000-2002
FRM Concentrations
St. Louis



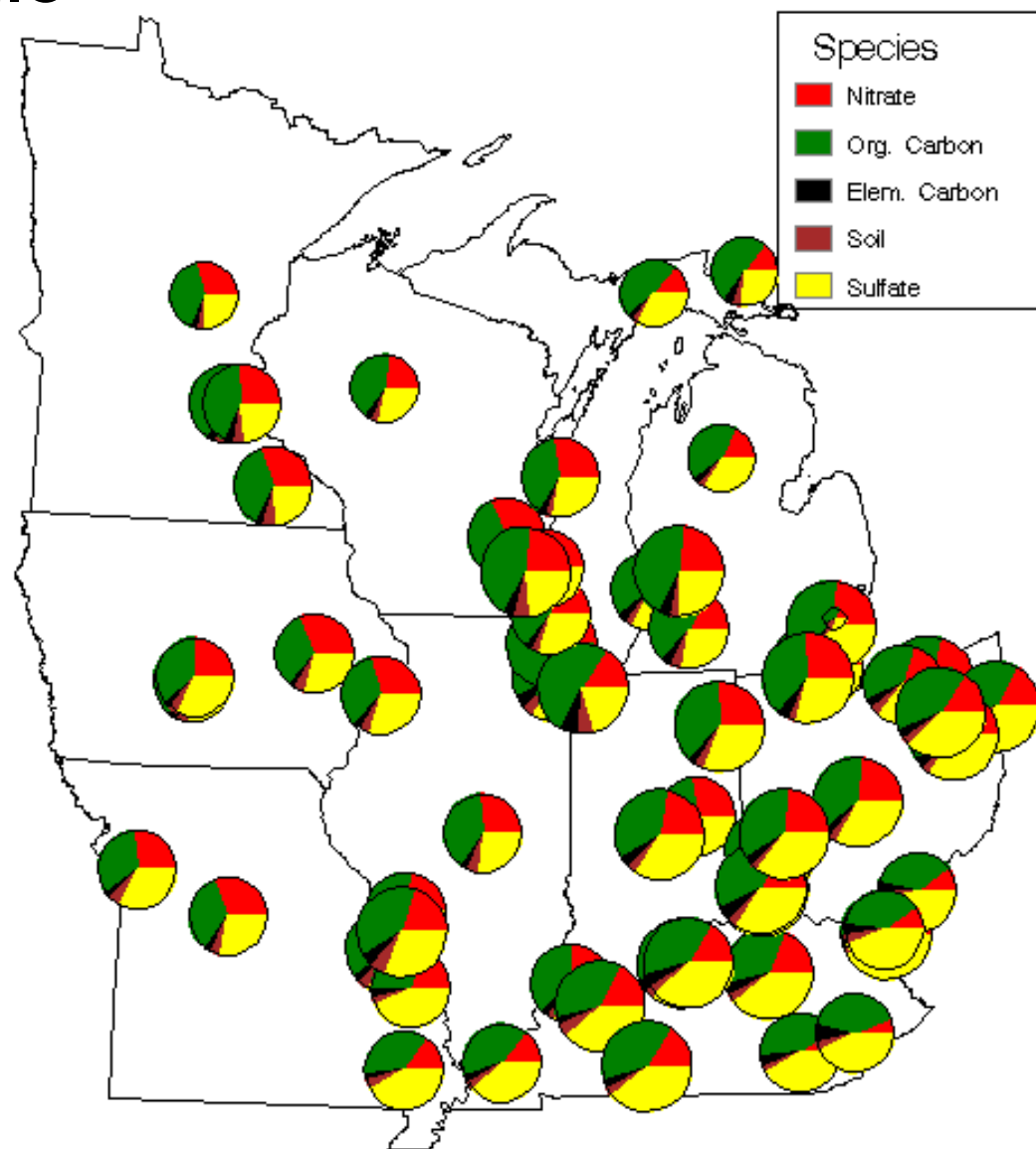
2000-2002 FRM Concentrations
Cleveland



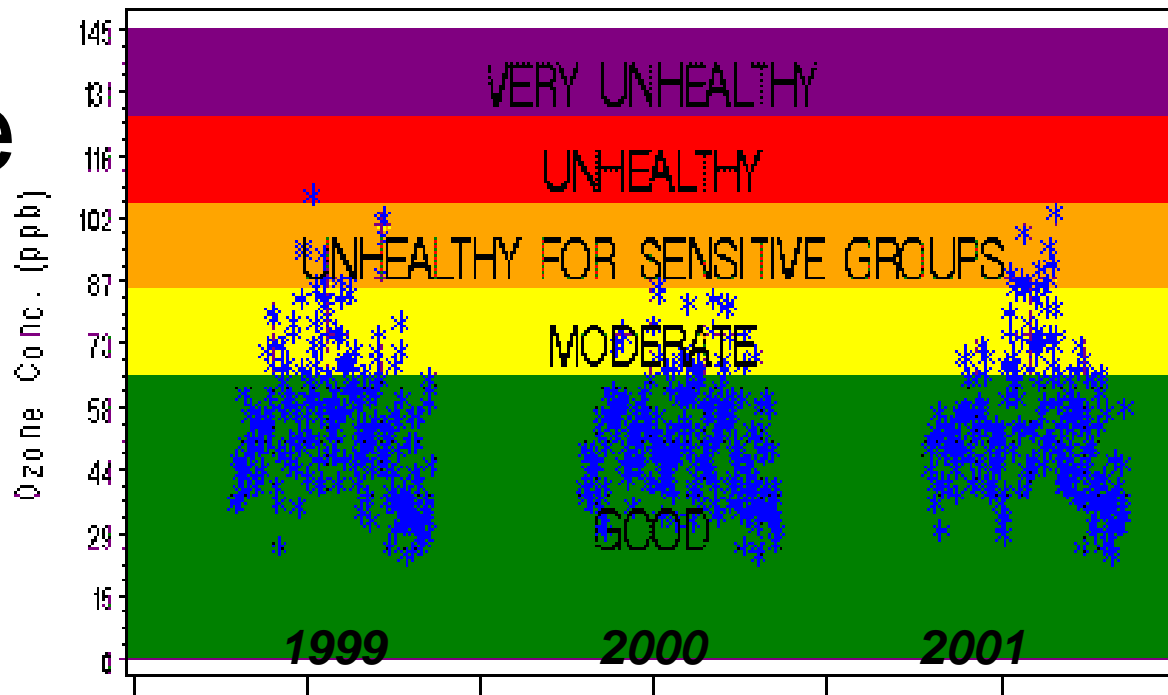
PM_{2.5}: Urban v. Regional



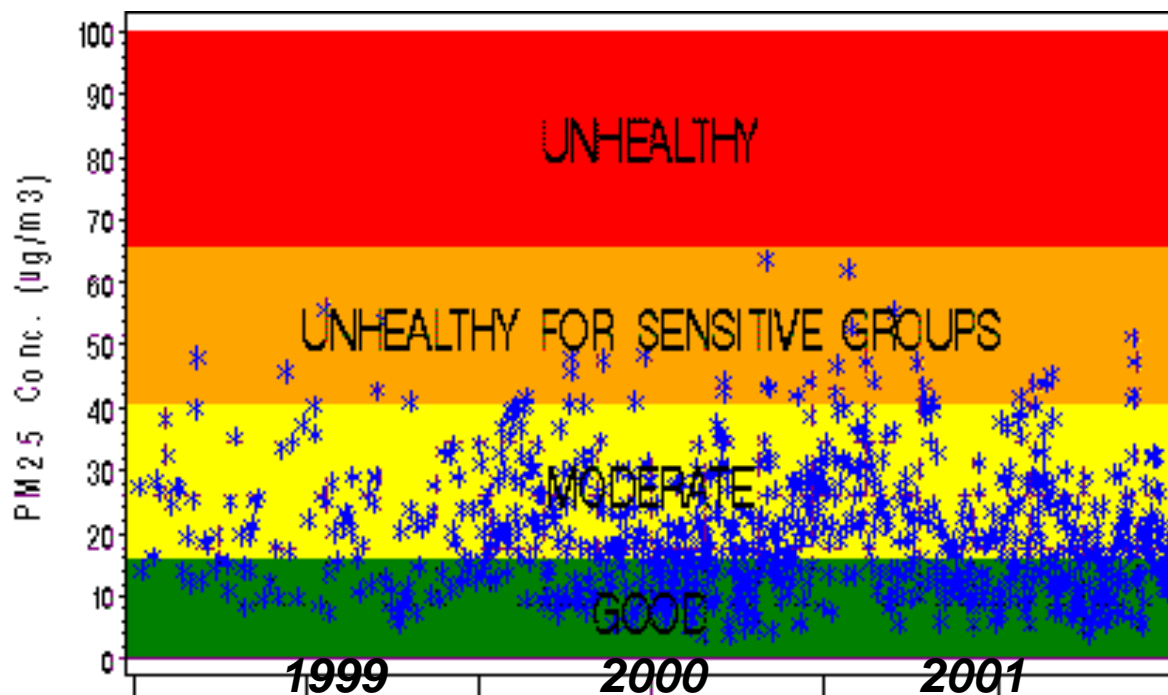
PM_{2.5}: Chemical Composition



Ozone



PM_{2.5}



Visibility Requirements

- Section 169A of CAAA of 1977 requires “as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in Class I areas which impairment results from manmade air pollution.”
- Visibility regulations (July 1, 1999) require “reasonable progress” to achieving *natural conditions* by the year 2064



**Map of 156 National Park and Wilderness Areas
Protected by EPA's Regional Haze Rule**

Legend:
NP= National Park
W= Wilderness
IP= International Park

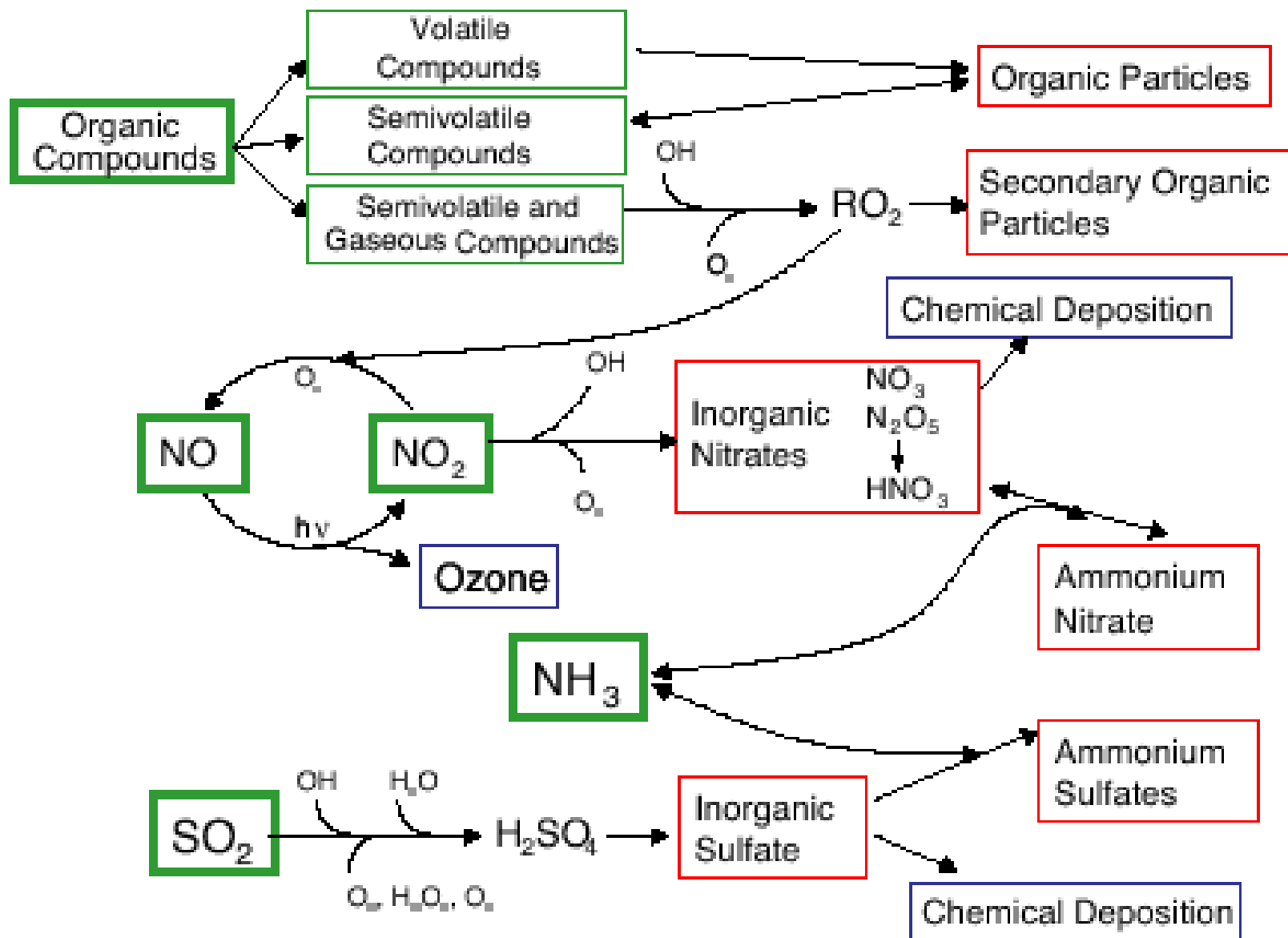
Isle Royale National Park, Michigan



Chicago, Illinois



“One Atmosphere”



Regional Planning Efforts

- Technical Analyses
- Emission Reduction Targets
- Control Strategy Options

Regional Planning: Principles

- Planning efforts should address multi-state, multi-pollutant requirements
 - Attainment of ozone and PM_{2.5} NAAQS appear to be the “driver” (i.e., regional emission reductions to meet NAAQS will also help meet haze goals)
- Existing controls (including CAIR) will improve air quality, but are not enough to attain NAAQS or meet haze goals everywhere
 - Many of the residual nonattainment sites are close to NAAQS
 - Most severe nonattainment (based on 2009 CAIR):

	Ozone	PM _{2.5}
Chicago	93	16.4
Milwaukee	91	
Cleveland	91	16.0
Detroit		17.4
Granite City (IL)		15.7

Regional Planning: Principles

- Attainment planning should focus on most severe residual nonattainment areas: Ozone-Lake Michigan region and Cleveland, PM_{2.5}-Detroit, Chicago, Granite City (IL), Cleveland
 - Other residual nonattainment areas expected to attain with regional controls
- A combination of local and regional controls needed to provide for attainment in most severe nonattainment areas:
 - Regional NO_x
 - Local OC (particle) and VOC (gas)
 - Regional SO₂

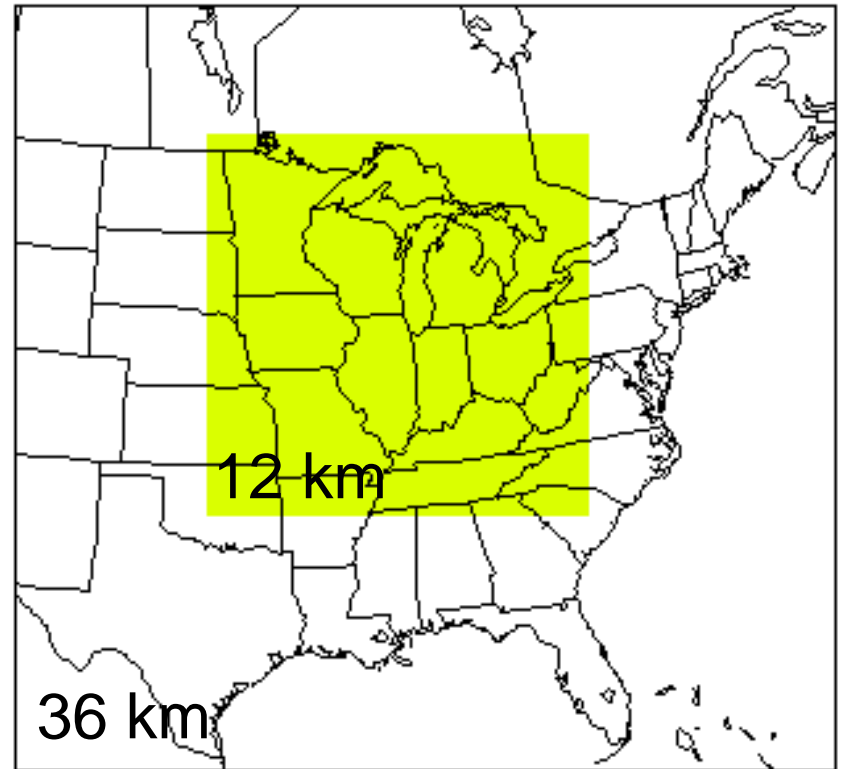
Technical Analyses: Modeling

Model: CAMx

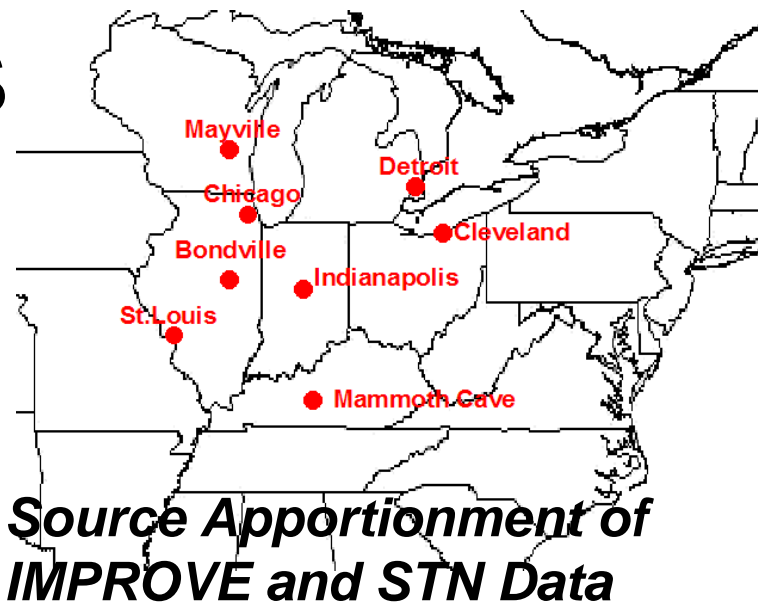
Domain/Grid: Eastern U.S.
(36 km), Midwest (12 km)

Year: 2002 (full year)
- PM/haze, 36 km

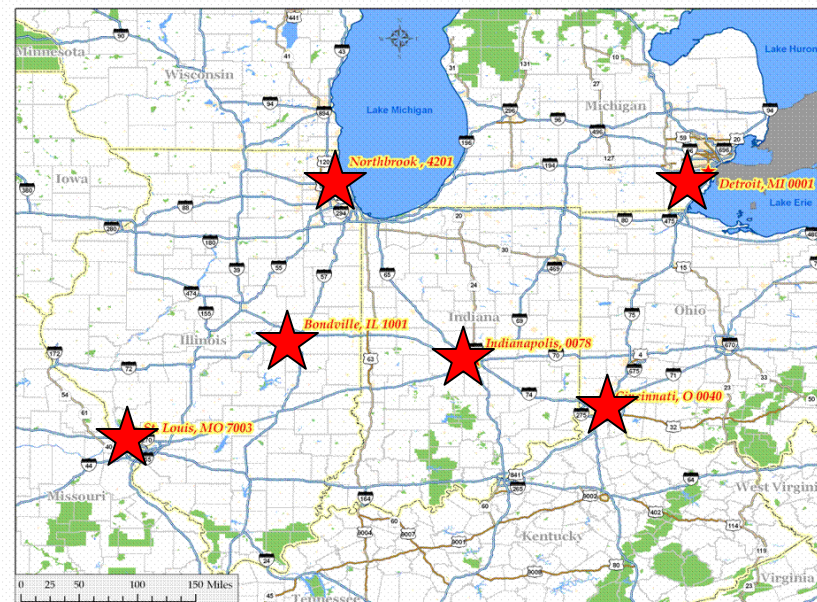
2001, 2002, 2003
(summer) – O₃, 12 km



Technical Analyses Monitoring and Data Analyses



Regional Ammonia Monitoring



Urban Organics Study

Control Strategy Modeling

- Strategy Analyses
 - Existing Control Programs
 - Candidate Control Programs
- Sensitivity Modeling
 - Emission Reduction Targets

Existing Control Programs

- **On-Highway Mobile Sources**

- Tier II/Low sulfur fuel
- Inspection/Maintenance programs (nonattainment areas)
- Reformulated gasoline (nonattainment areas)

- **Off-Highway Mobile Sources**

- Federal control programs incorporated into NONROAD model (e.g., nonroad diesel rule), plus the evaporative Large Spark Ignition and Recreational Vehicle standards
- Heavy-duty diesel (2007) engine standard/Low sulfur fuel
- Federal railroad/locomotive standards
- Federal commercial marine vessel engine standards

- **Power Plants**

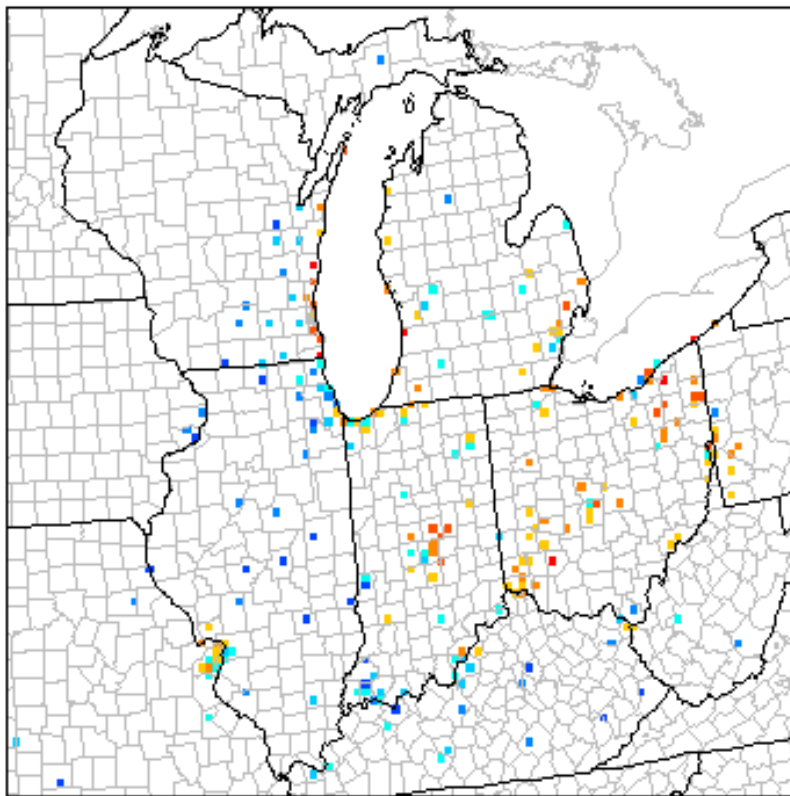
- Title IV (Phases I and II)
- NOx SIP Call
- Clean Air Interstate Rule

- **Other Point Sources**

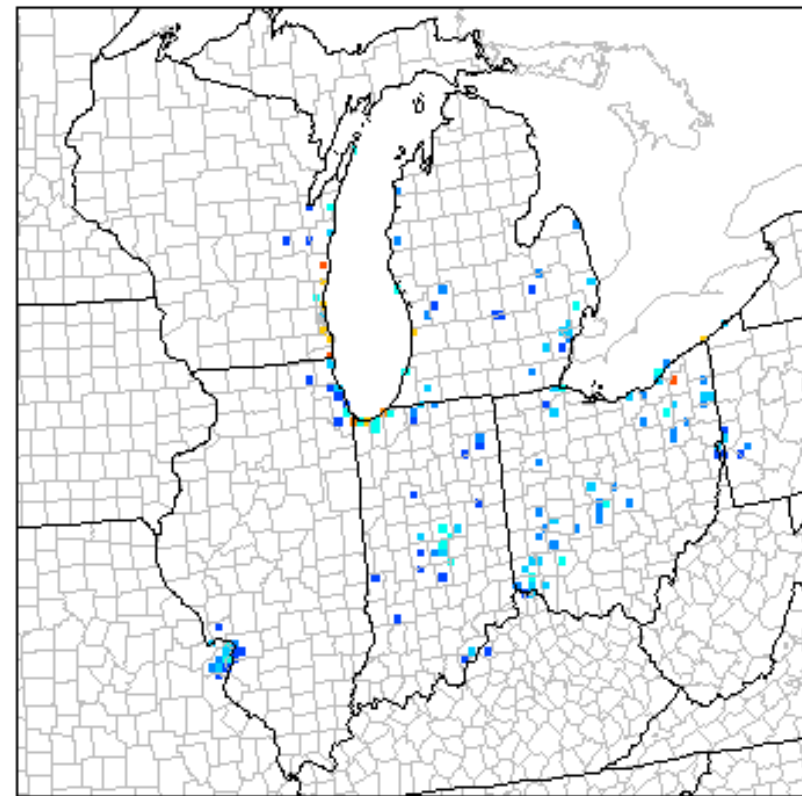
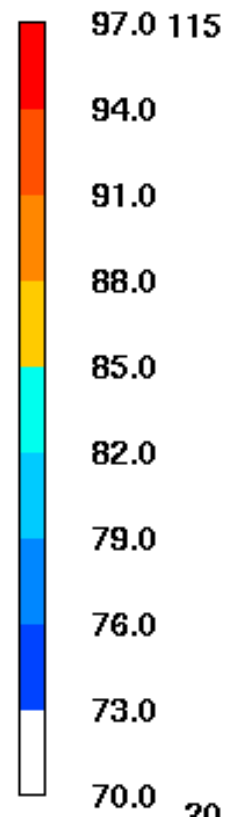
- VOC 2-, 4-, 7-, and 10-year MACT standards
- Combustion turbine MACT
- Industrial boiler/process heater/RICE MACT

Ozone Results

2002 (observed)

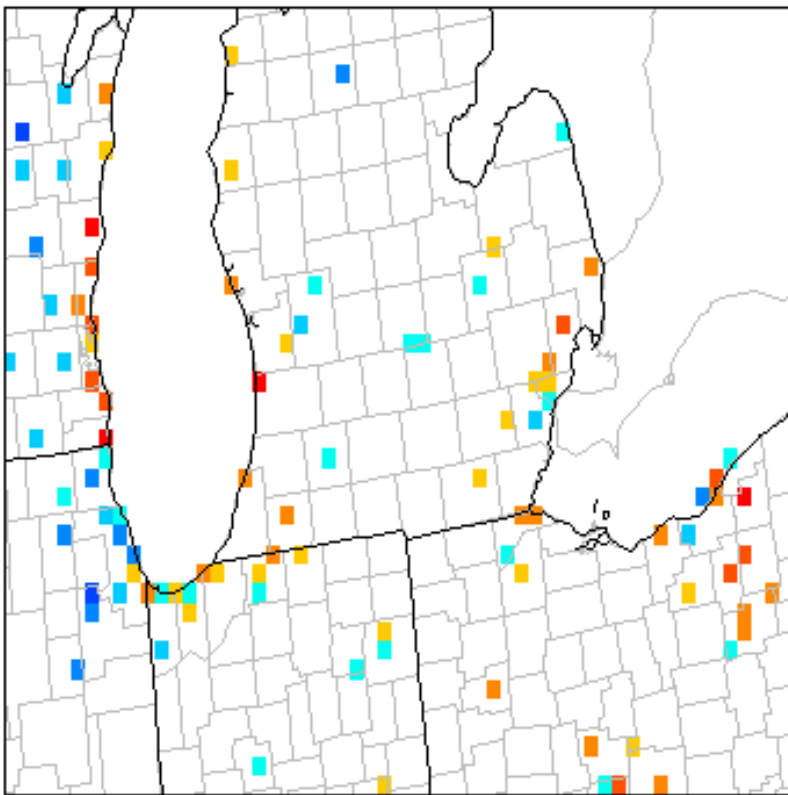


2009 (projected)

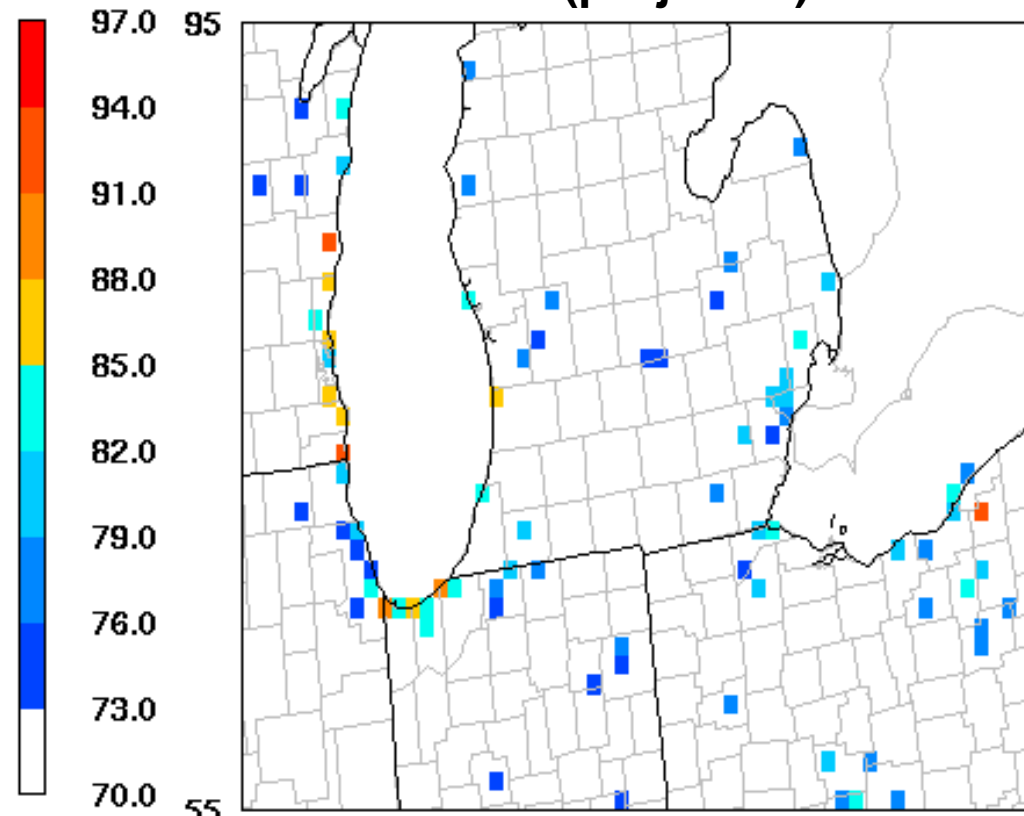


Ozone Results

2002 (observed)

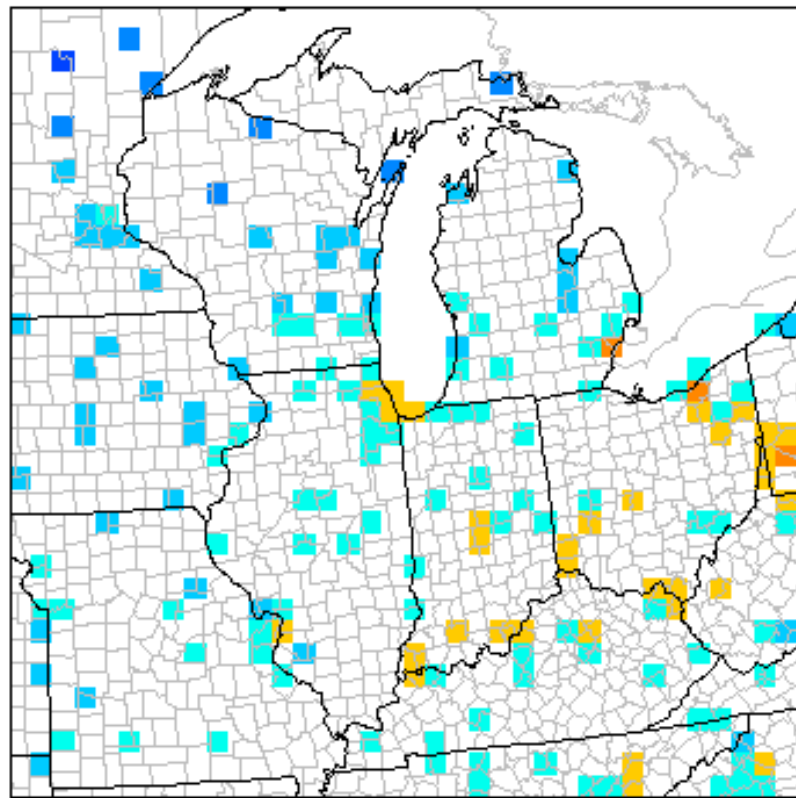


2009 (projected)

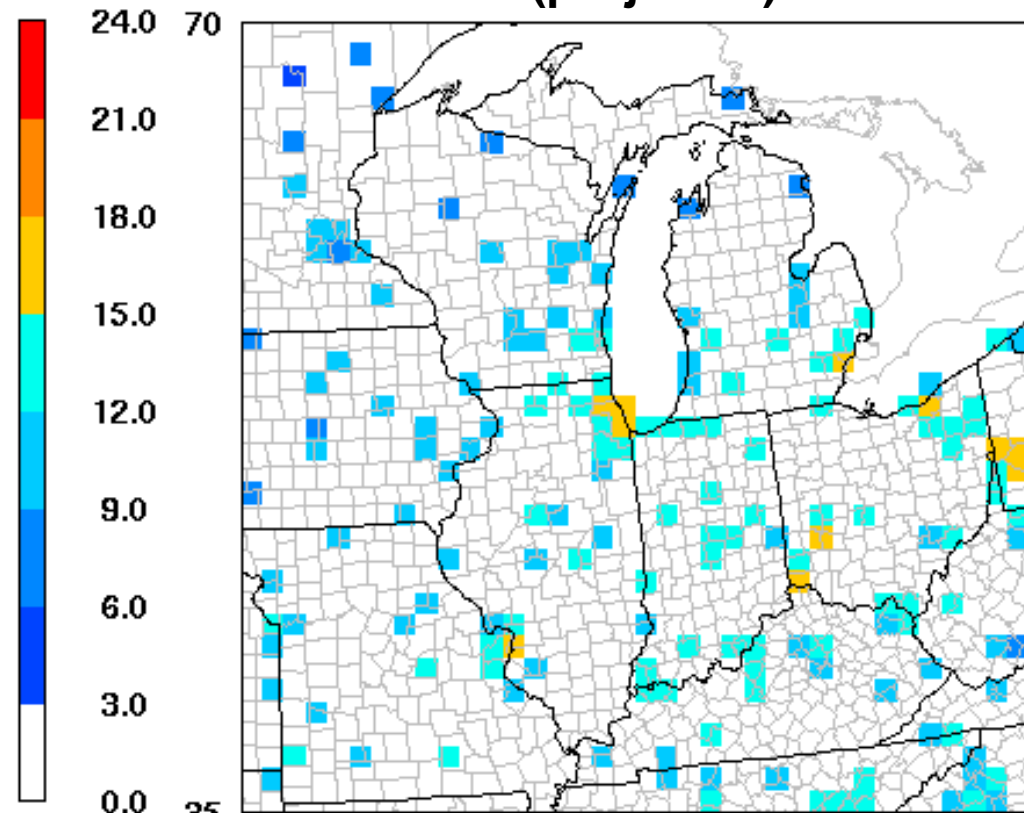


PM_{2.5} Results

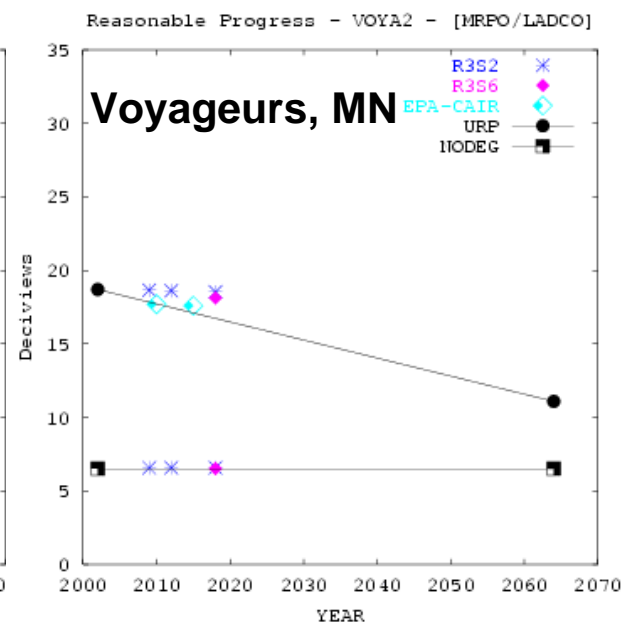
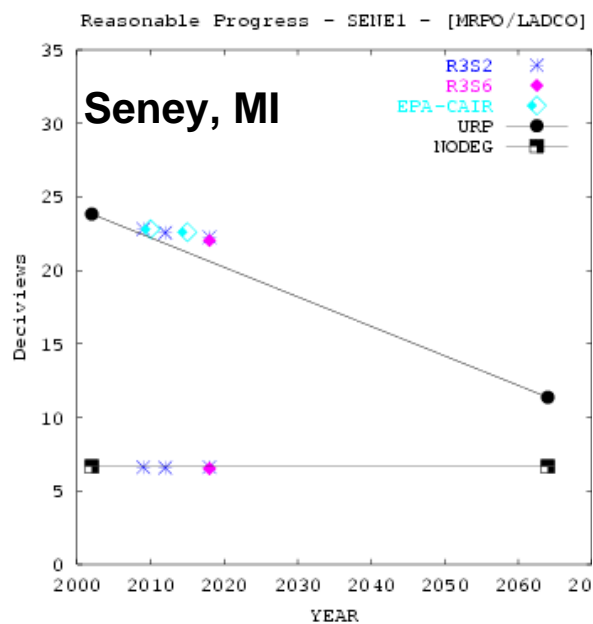
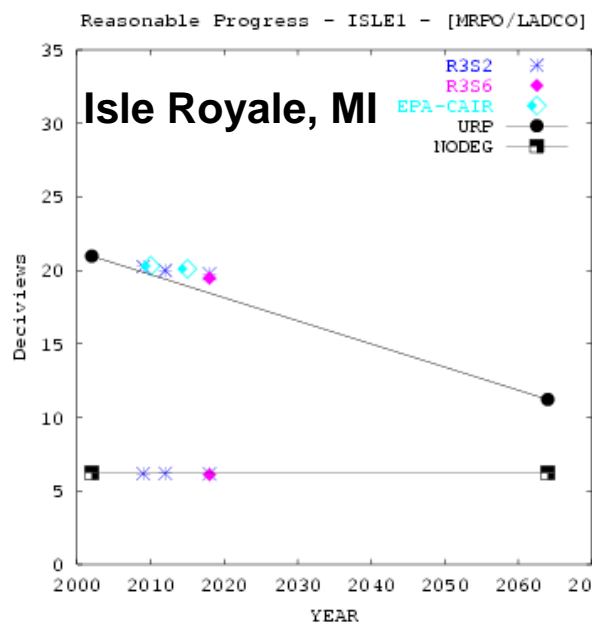
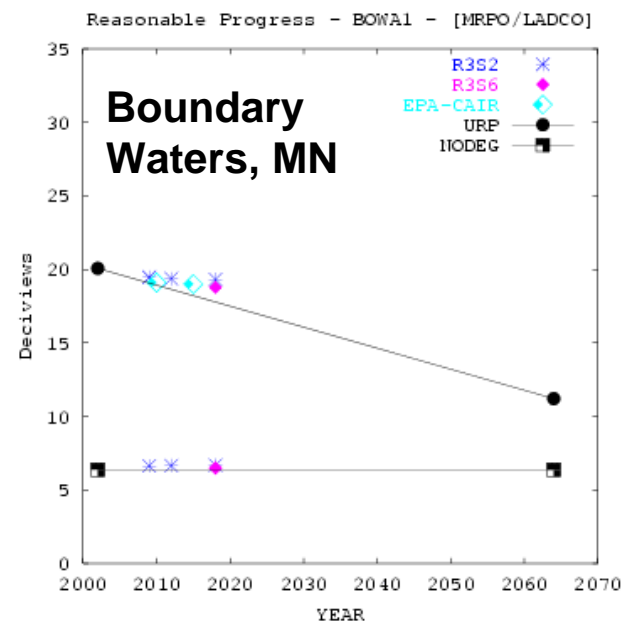
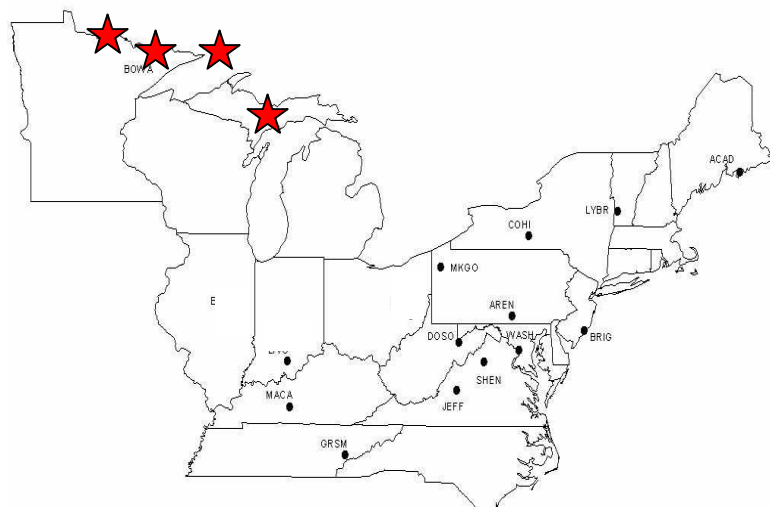
2002 (observed)



2009 (projected)



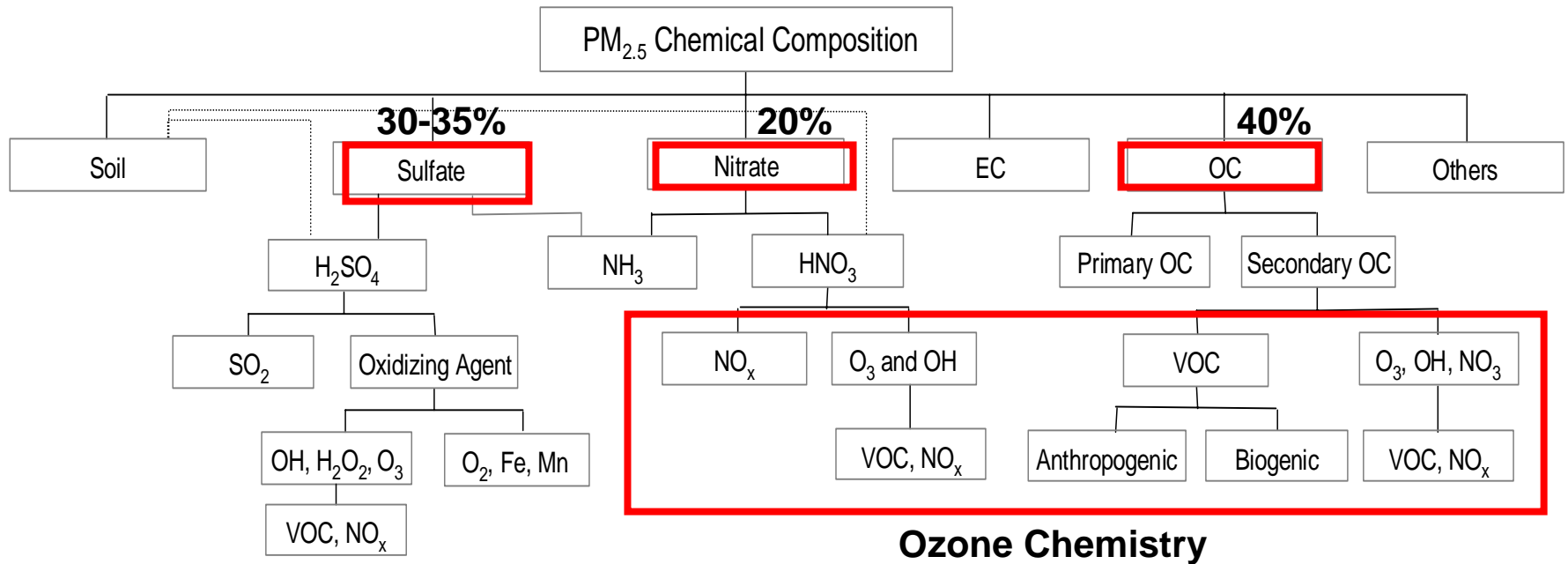
Regional Haze Results



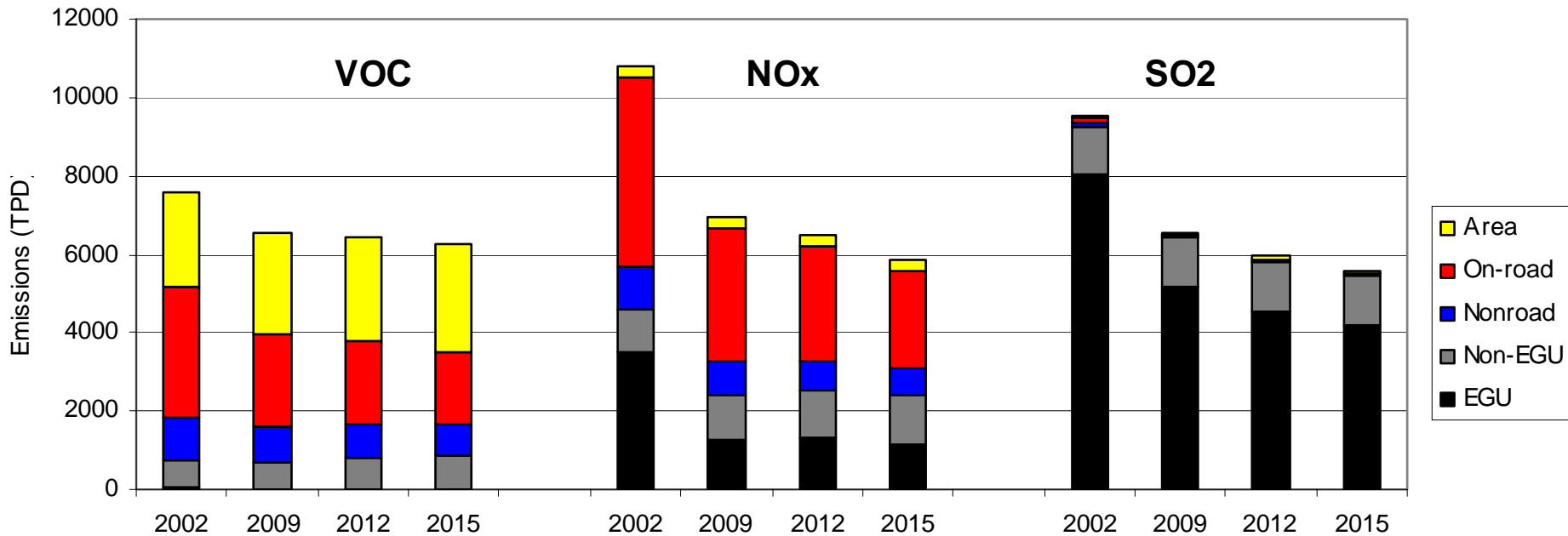
Control Strategy Options: Issues

- Precursors/pollutants
- Source sectors/control measures
- Geographic coverage
- Timing
- Level of control

Precursors/Pollutants



Source Sectors/Control Measures

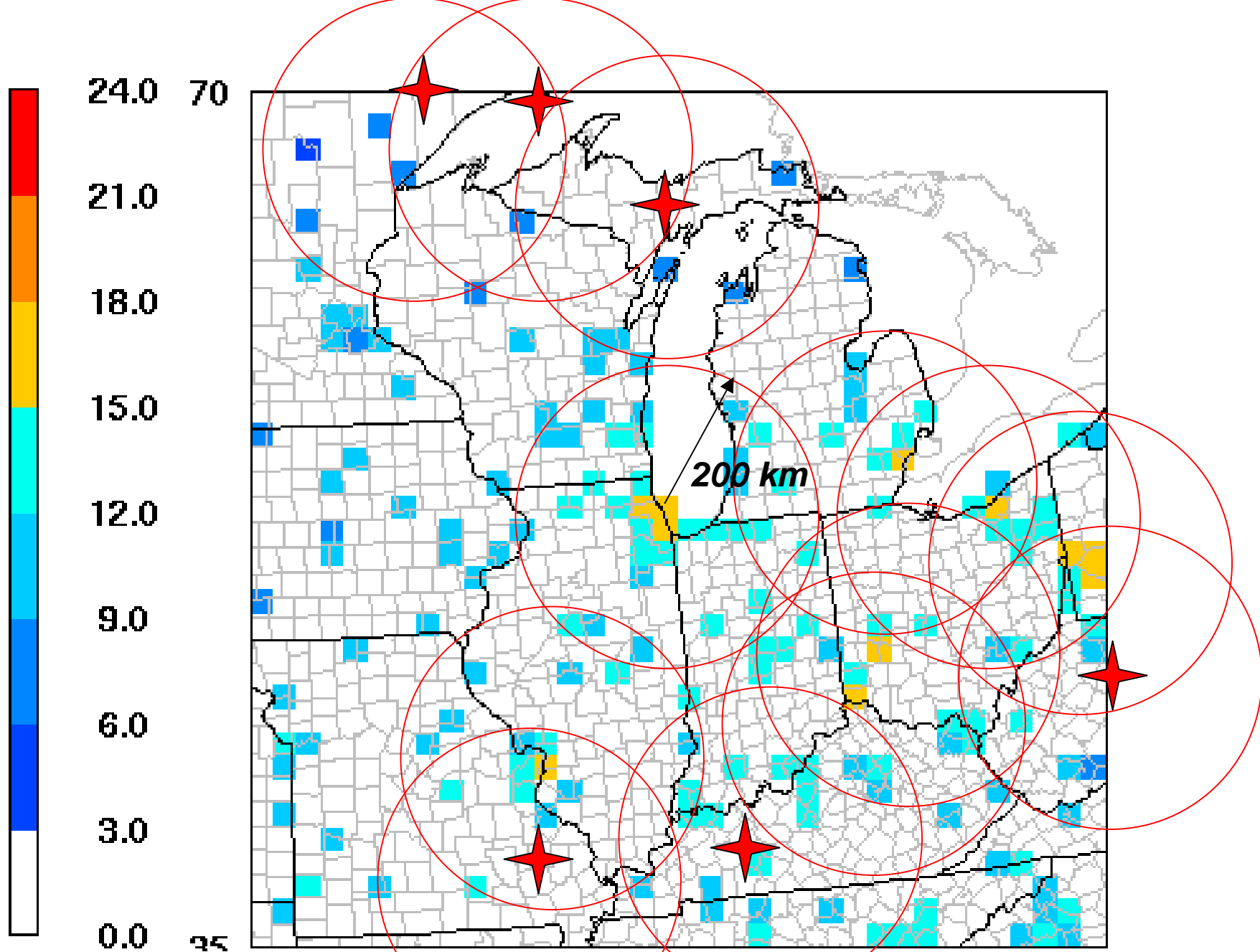


Geographic Coverage

- Ozone
 - VOC reductions effective in urban areas
 - NO_x reductions effective on regional scale
- PM_{2.5}
 - Sulfate mostly regional
 - Nitrate also regional, but somewhat local, too
 - Organic carbon mostly local
- General
 - Closer-in reductions more effective than farther-away reductions
 - Expanding the geographic area for a regional program (at the same control level) will provide additional air quality benefit
 - Expanding the geographic area for a regional program (at a lesser control level) can provide similar air quality benefit

Case for Regional Controls

- PM_{2.5} largely regional
 - Yes, CAIR will help, but PM still dominated by regional component
- Numerous residual PM_{2.5} nonattainment and Class I areas across region (see maps on following slides)
- Regional SO₂ reductions lower PM-sulfate, regional NOx reductions lower PM-nitrate and ozone
- Local OC reductions also beneficial, but identification of OC sources uncertain
- Local VOC reductions also beneficial, but not possible to attain with just these reductions

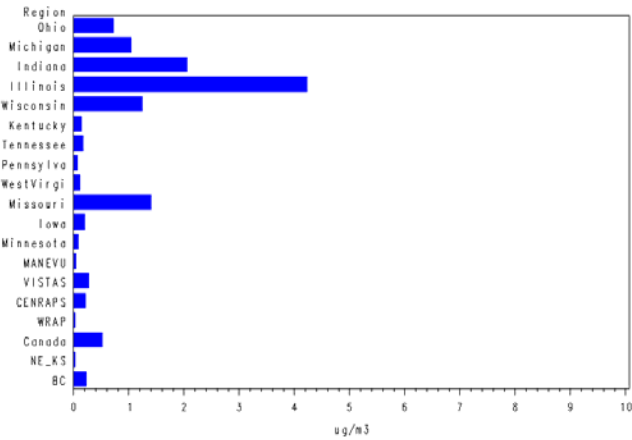


Round 3: 2009 CAIR

PM_{2.5} - Sulfate

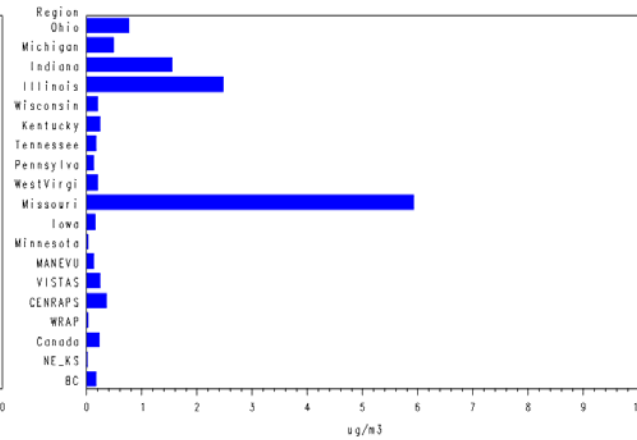
Chicago, IL

170310022



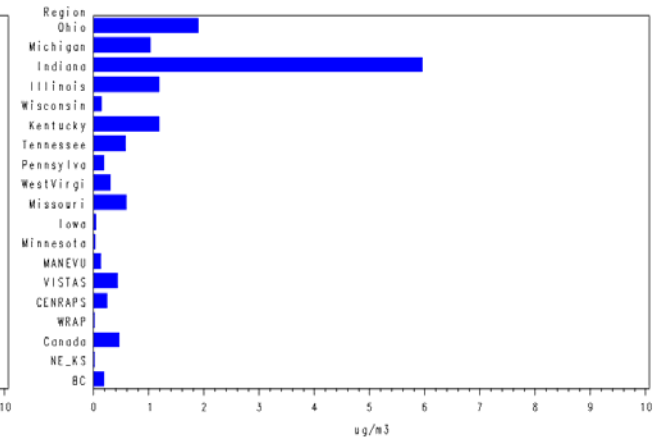
Granite City, IL

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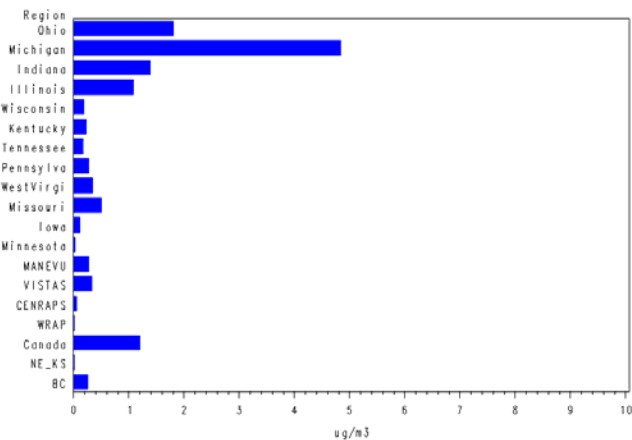
Louisville, KY

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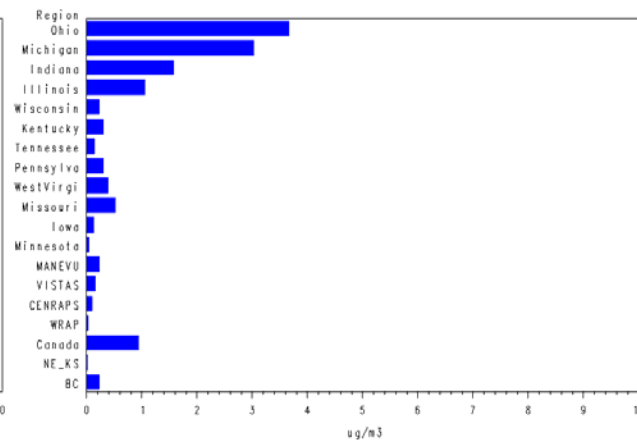
Detroit, MI

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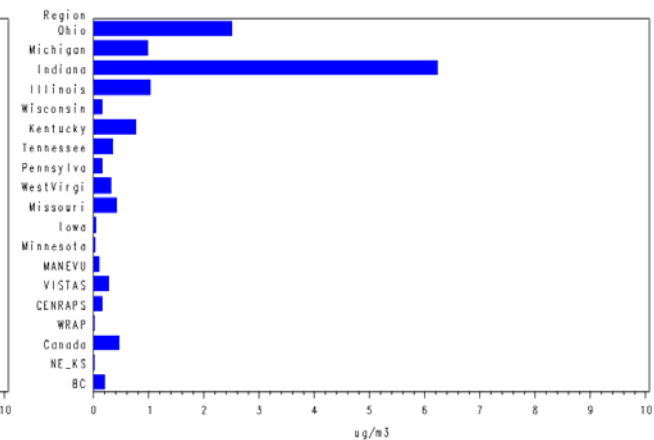
Cleveland, OH

390350038



Cincinnati, OH

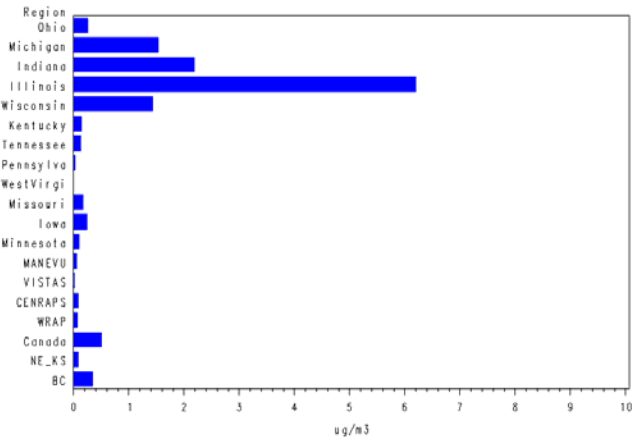
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PM_{2.5} - Nitrate

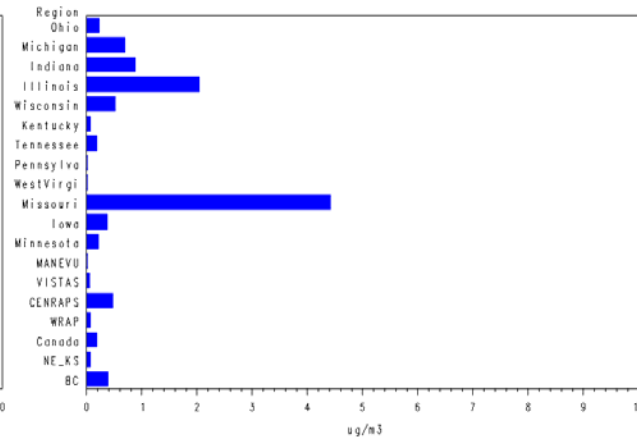
Chicago, IL

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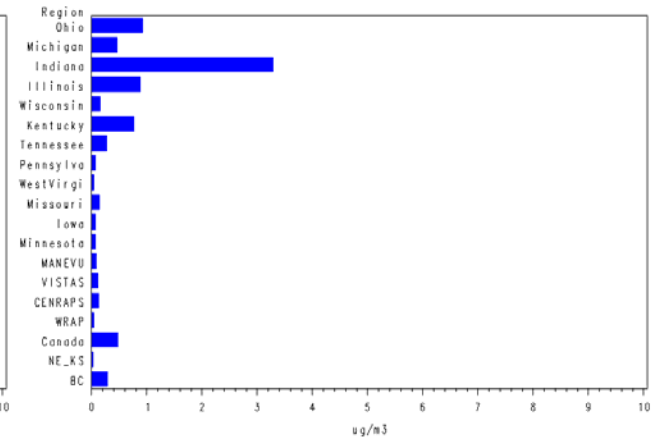
Granite City, IL

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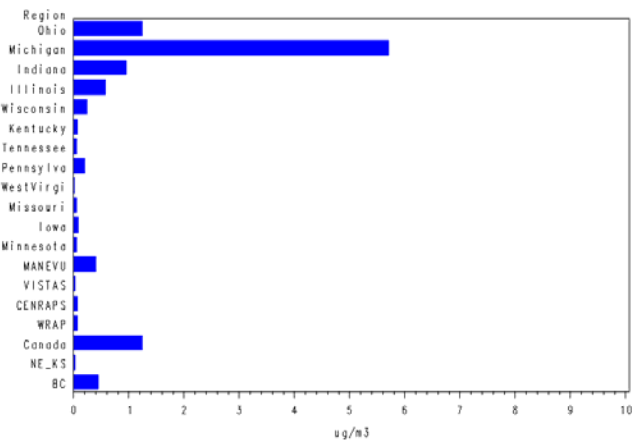
Louisville, KY

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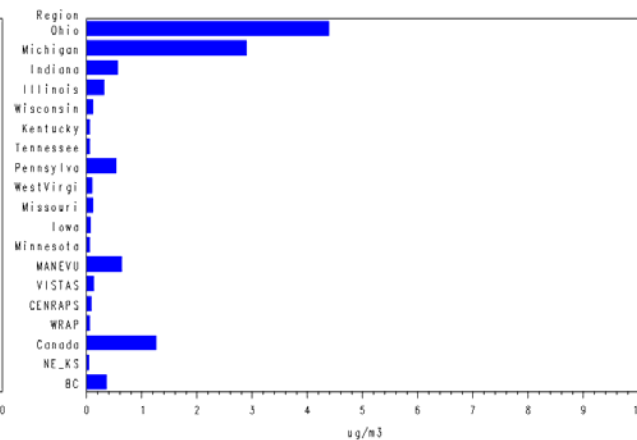
Detroit, MI

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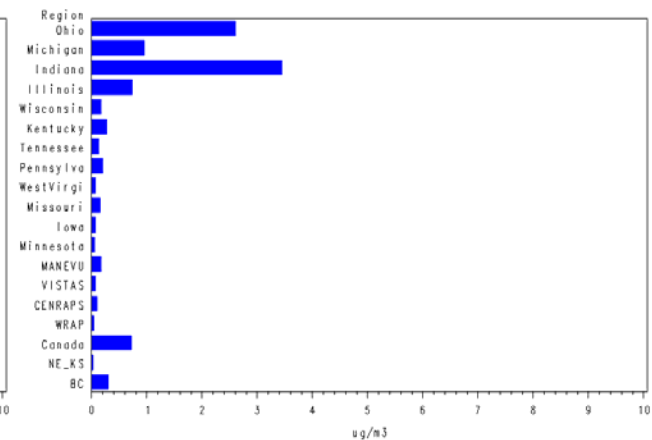
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Cincinnati, OH

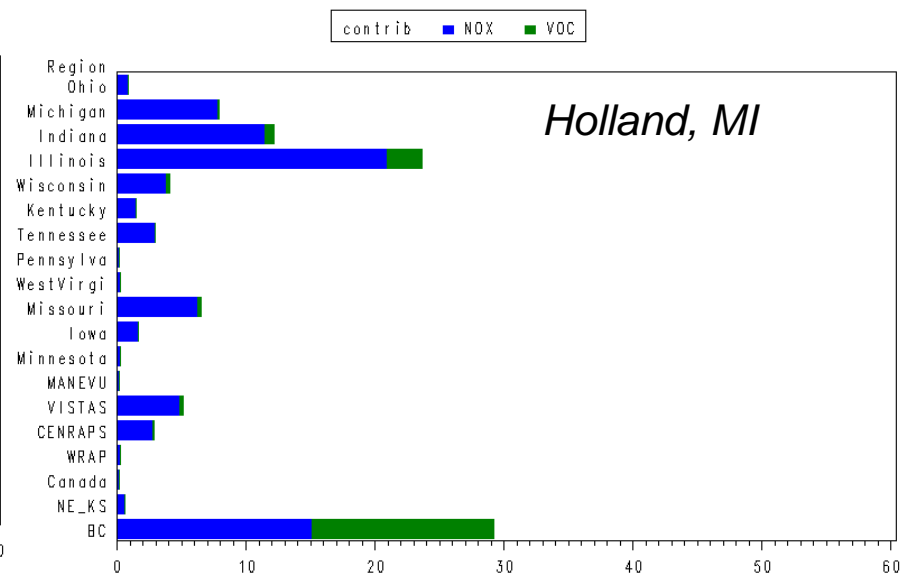
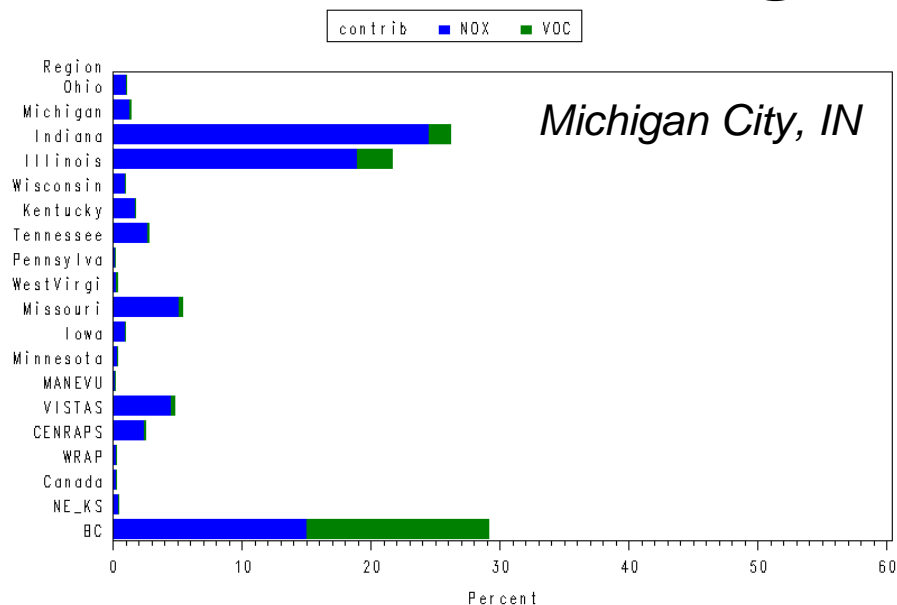
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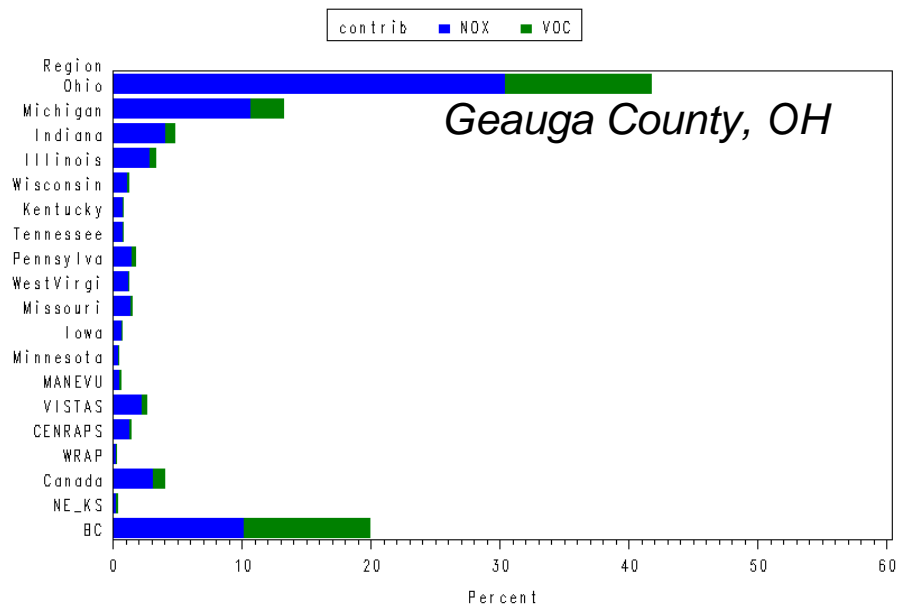
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Ozone

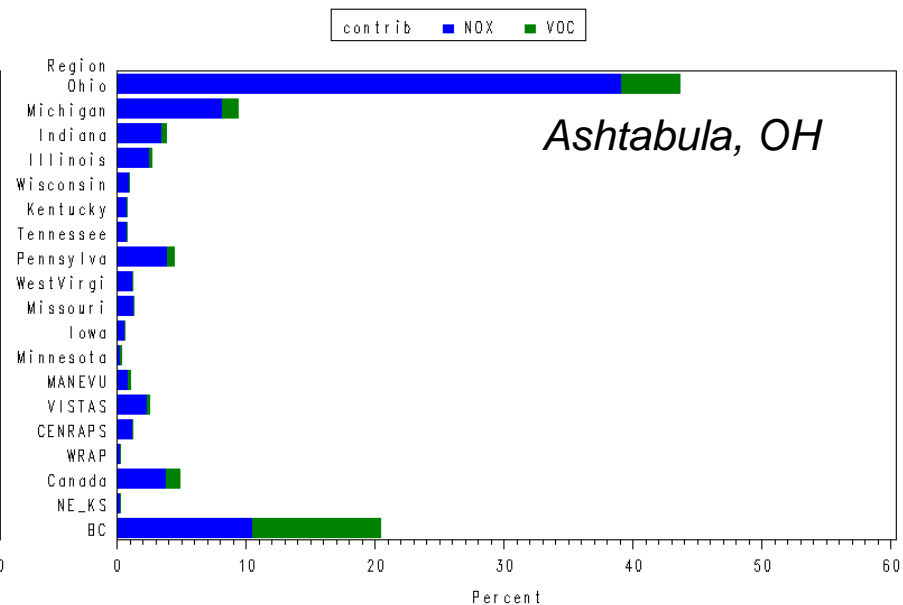
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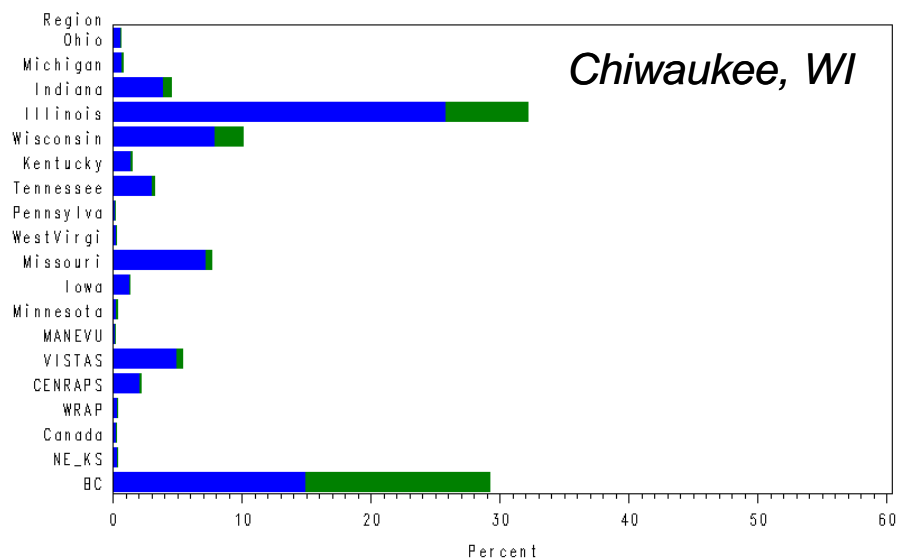


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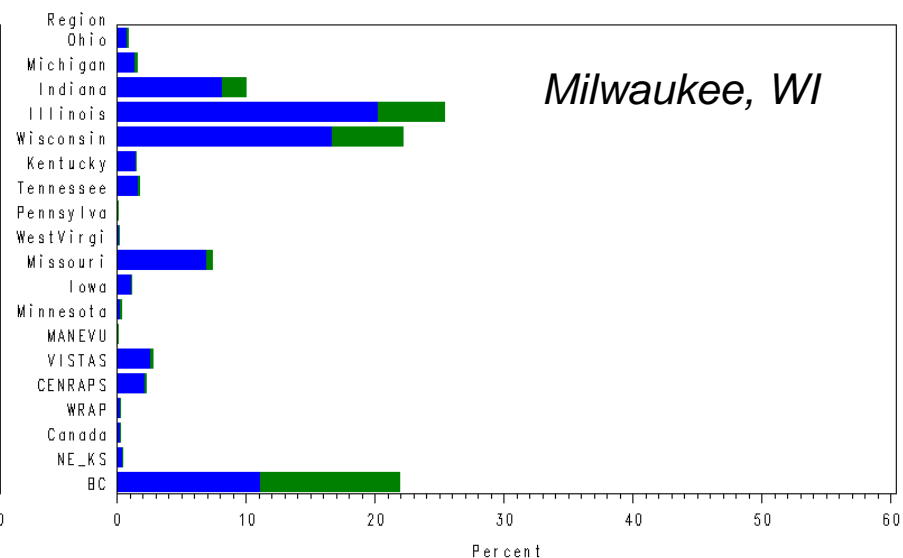
Ozone

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contrib NOX VOC

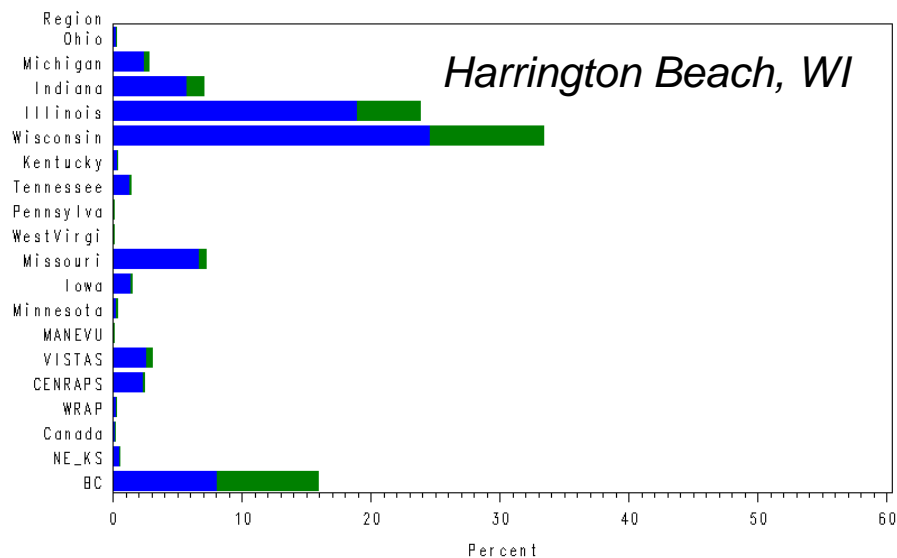


contrib NOX VOC



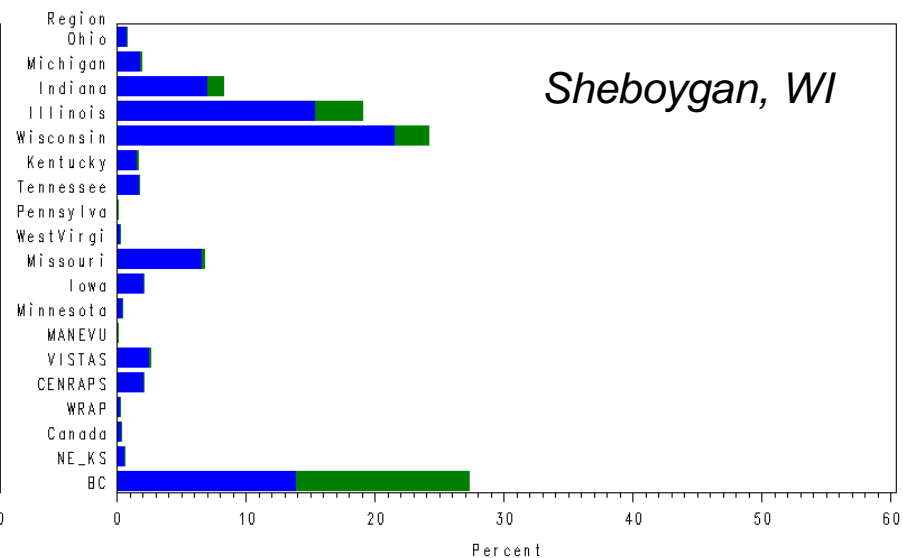
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contrib NOX VOC

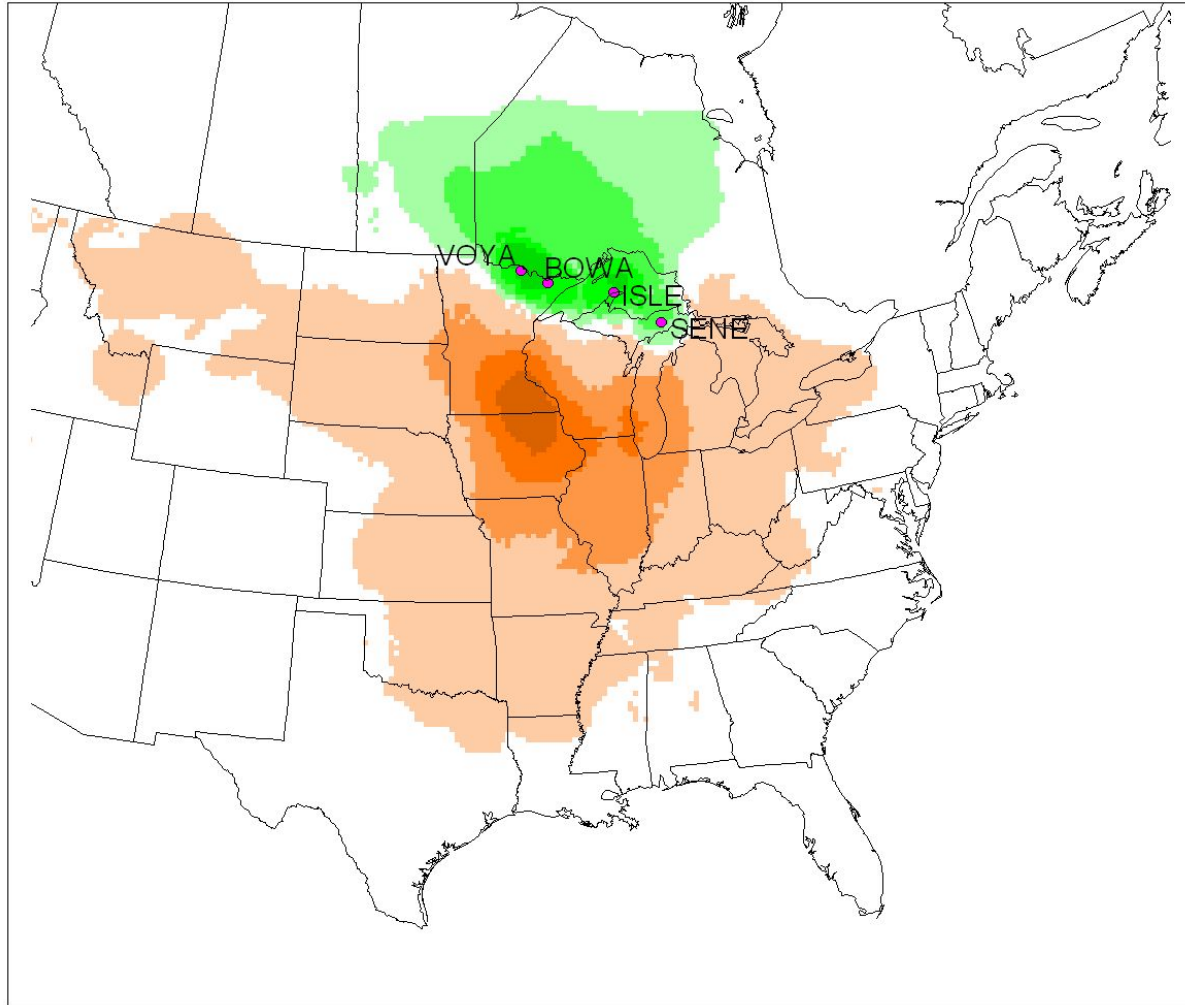


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contrib NOX VOC



Areas Contributing to Visibility Impairment



Orange is where air is most likely to come from on poor air quality days, green is where air is least likely to come from on poor air quality days

Timing

- Attainment Dates

- Ozone: 2007 (marginal)
2009 (basic)
2010 (moderate)
- PM_{2.5}: 2010
- Haze: 2018 (1st milestone)

- Continued Benefits of Existing Control Programs

- CAIR (Phase II – 2015)
- BART (2013)
- On-highway and off-highway mobile source controls, etc.

Level of Control

- How much control depends on:
 - Air quality goal
 - Precursors/pollutants to be controlled
 - Source sectors to be controlled/viable control measures
 - Geographic area over which controls applied
- Reasonable starting point for policy discussions:
 - Regional NO_x: 25-35%
 - Local VOC and OC: 25-35%
 - Regional SO₂: 25-35%

Possible Stationary Source Control Measures

- **Point Sources**

- Electric Generating Units
- Industrial/Commercial/Institutional (ICI) Boilers
- Cement Kilns
- Petroleum Refineries
- Iron & Steel Plants
- Chemical Plants
- Surface Coating
- Degreasing

- **Area Sources**

- Industrial Surface Coating
- Degreasing
- Architectural Coatings
- Portable Fuel Containers
- Consumer Products
- Auto Refinishing
- Gasoline Dispensing Facilities

Possible Mobile Source Control Measures

- **Heavy-Duty Diesel Vehicles**

- Retrofit programs
- Accelerate turnover of older vehicles with new, cleaner vehicles or alternative fuel vehicles
- Repower older , high emitting engines with low emitting engines
- Accelerate “reflashing” programs

- **Diesel Vehicles/Equipment**

- Use of reformulated fuels

- **Diesel Equipment**

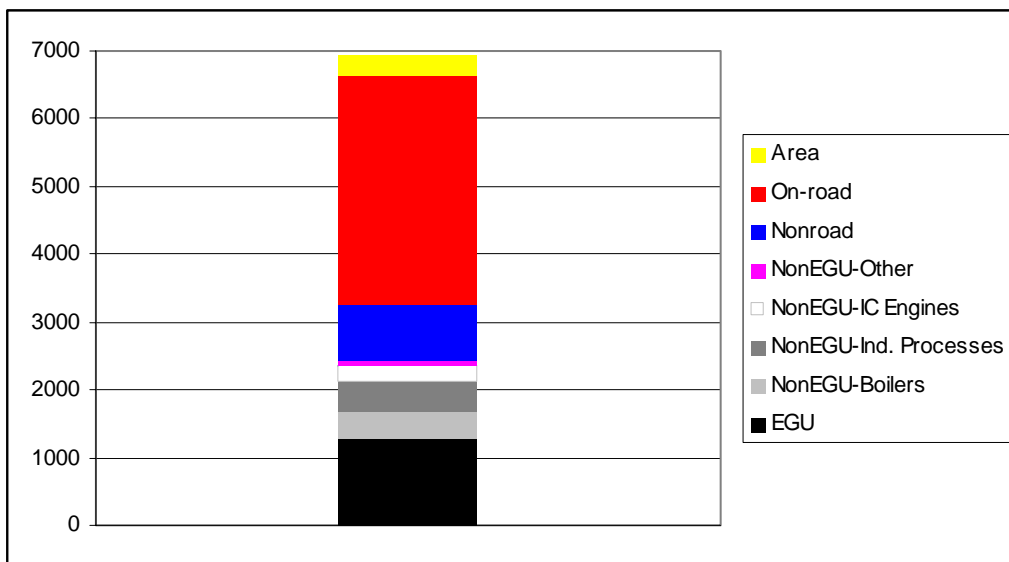
- Accelerated turnover of current vehicles with lower emitting vehicles or alternative fuel vehicles
- Diesel Equipment
- Retrofit programs
- Accelerate use of Tier 2,3,4 engines

- **Light Duty Vehicles**

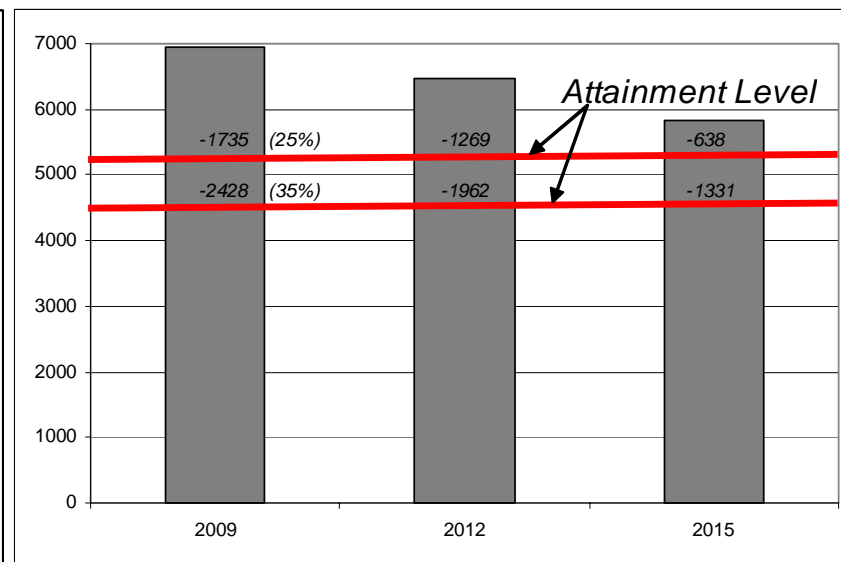
- Accelerated turnover of current vehicles with lower emitting vehicles or alternative fuel vehicles

NOx Control Programs

2009 Regional Emissions

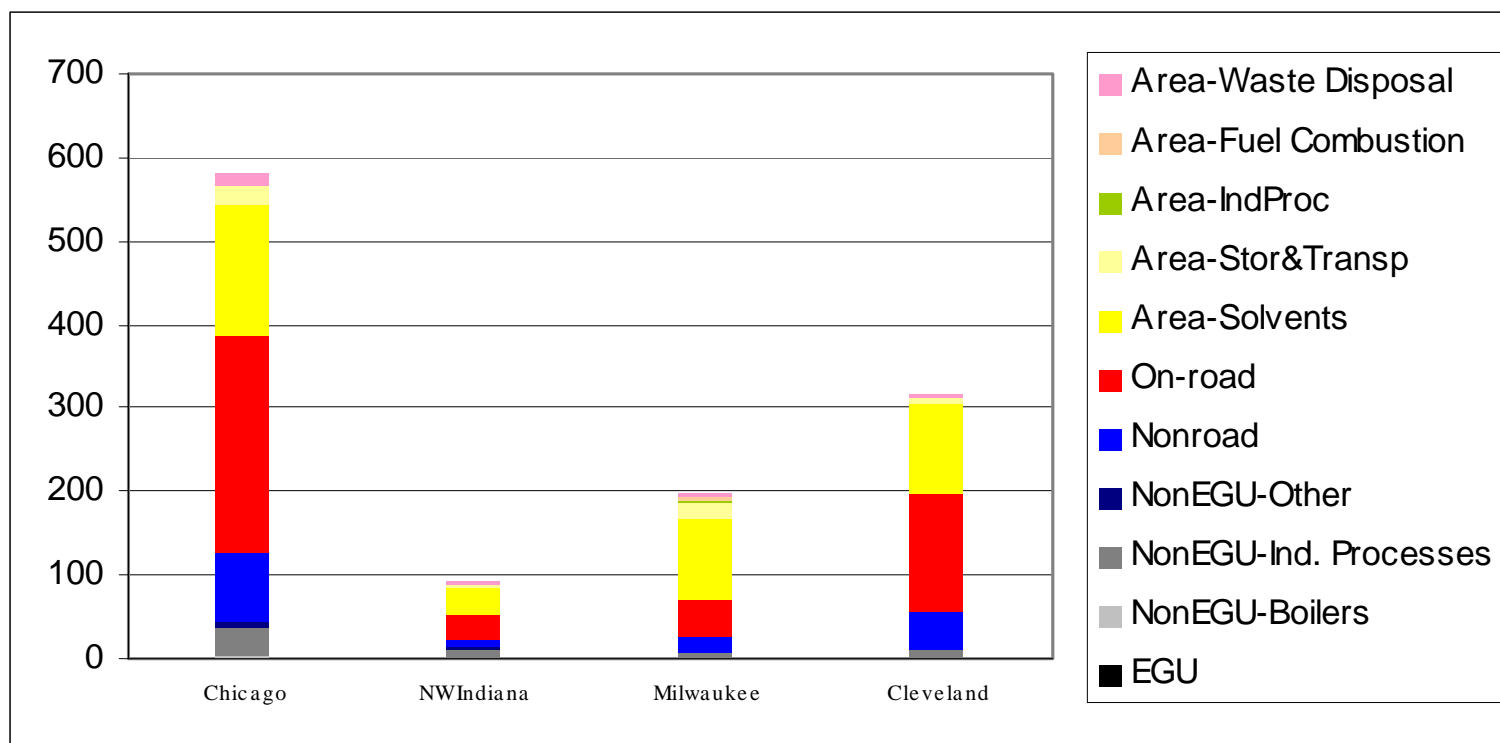


Emission Reduction Targets



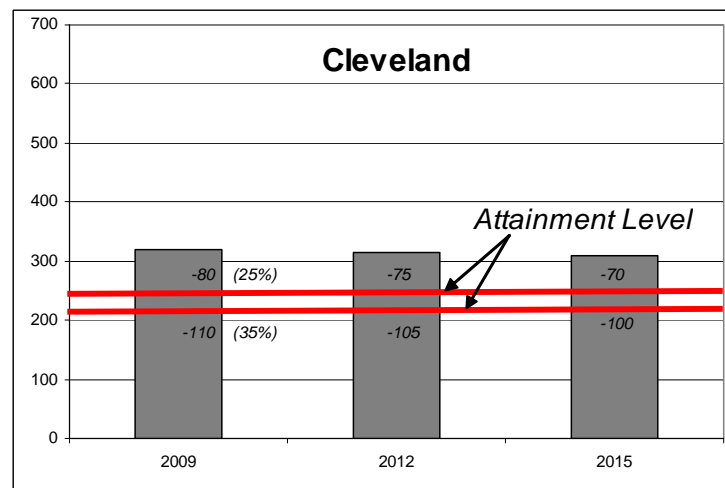
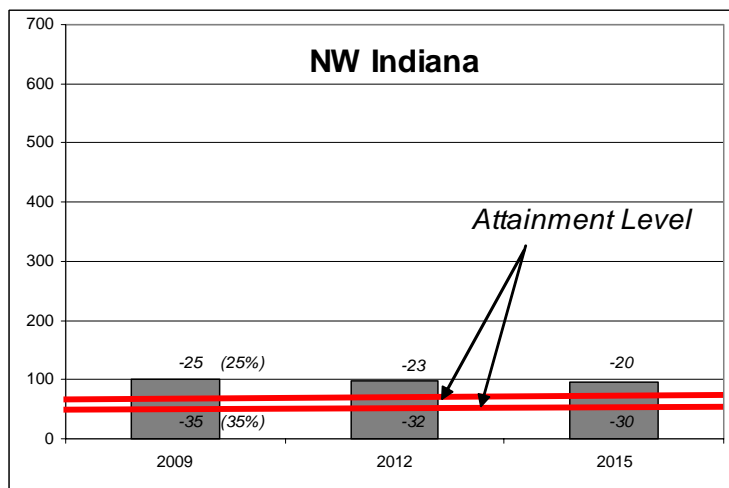
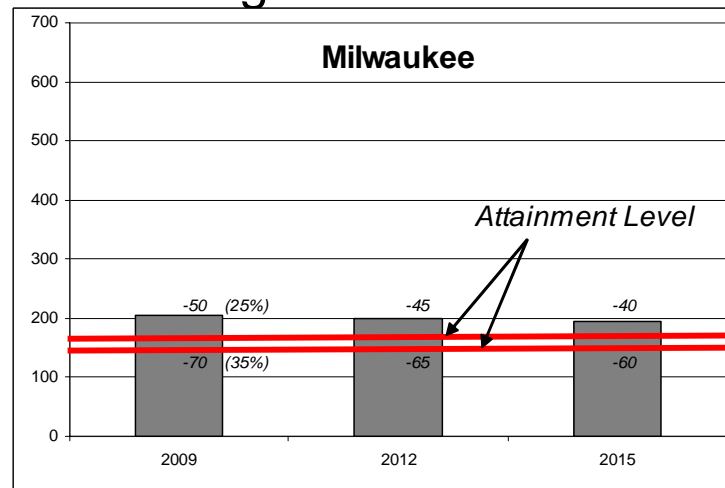
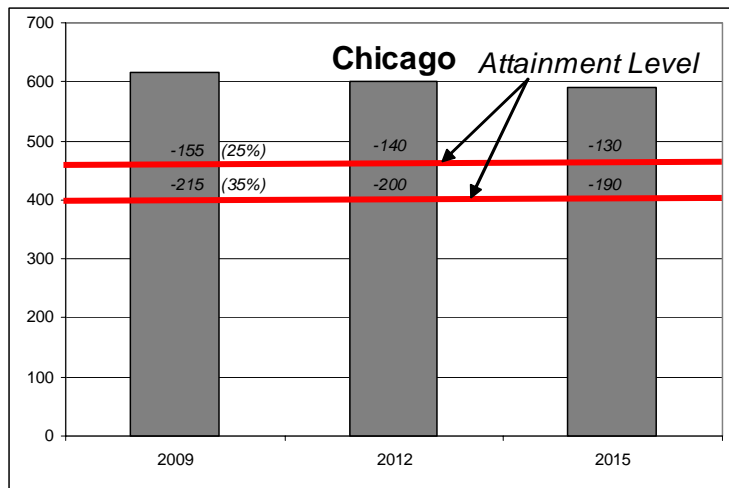
VOC Control Programs

2009 Regional Emissions



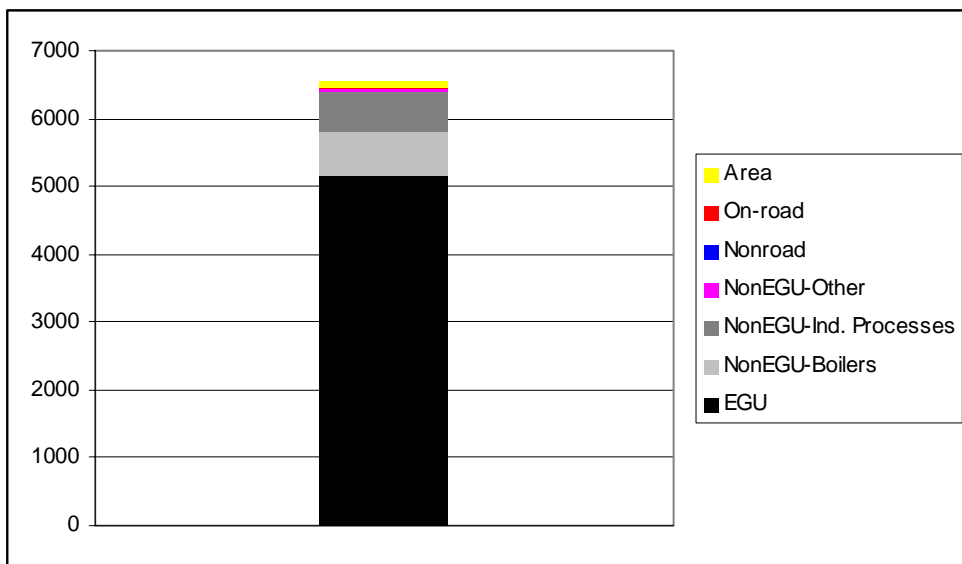
VOC Control Programs

Emission Reduction Targets

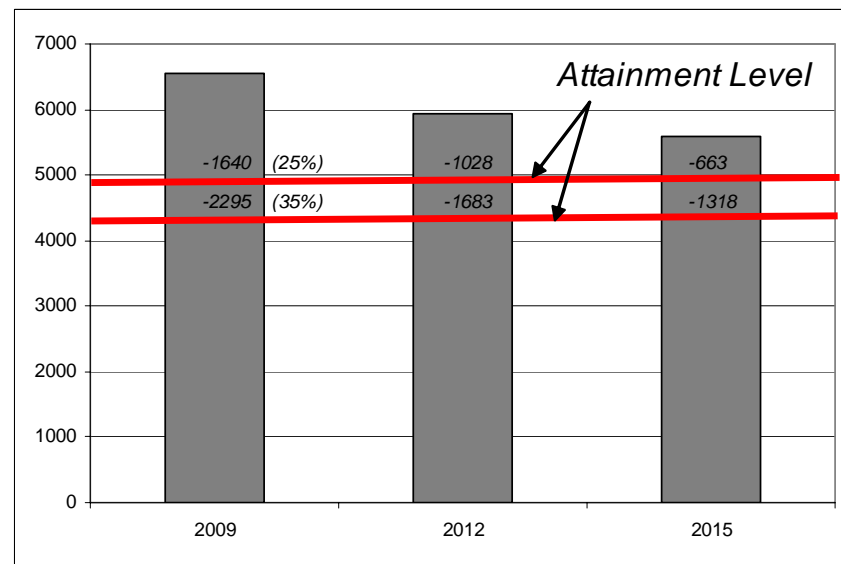


SO₂ Control Programs

2009 Regional Emissions



Emission Reduction Targets



Control Options: Summary

- Regional NO_x reductions
 - Important given multi-pollutant benefits
 - Must include significant mobile source controls, which do not provide much reduction and are very expensive
- Local VOC reductions
 - Candidate area source measures get about 15%
- Local OC reductions
 - Difficult to achieve, given limited understanding of sources
- Regional SO₂ reductions
 - May be necessary, given lack of sufficient NO_x and OC reductions

How do these control programs effect visibility?

[illegible]

Key Regulatory Dates

	Ozone	PM_{2.5}	Haze
Nonattainment Designations	April 15, 2004 <i>(June 15, 2004)</i>	Dec 17, 2004 <i>(April 5, 2005)</i>	-----
SIPs due	June 2007	April 2008	Dec 2007
Attainment dates	2010	2010	2018 (2064)

Summary

- Regional, multi-pollutant planning approach
- SIPs for ozone (8-hour) and PM_{2.5} due in mid-2007 and early 2008, respectively
 - Need to identify control strategies by early 2006
- Modeling shows existing controls will improve air quality, but not enough to meet air quality standards
 - Need combination of local and regional controls
- Examination of additional, possible control measures is on-going

For additional information....

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- www.ladco.org
www.ladco.org/Regional_Air_Quality.html